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SCIENCE AND BELIEF IN SCOTLAND,

1805-1868:

THE SCOTTISH EVANGELICALS

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For my Mum and Dad

"Protestantism is the true religion of science; the right of private judgement, the legitimate counterpart of the inductive philosophy."

[Hugh Miller], 'The Anti-Geologists', Witness, October 28, 1846

"Long after the Reformation had placed the Scriptures in the hands of the laity, physical creation was regarded both by them and by the clergy as a grand arena in which diabolical agency competed with the powers of man: they believed, and acted on their belief, in witchcraft and sorcery; they committed thousands to the flames for imaginary offences, and manifested a dark and cruel spirit, in direct opposition to that of Christianity. It was advancing science that delivered the public mind from these disgraceful bewilderments, and revealed to the human intellect the world in all its magnificence and beauty, as the direct workmanship of God, replete with irrefragable proofs of his power, wisdom and goodness."

'Report of Mr Combe's Address to the Philosophical Association, delvered at the Close of his lectures on Moral Philosophy, on 21st March, in the Waterloo Rooms.' Reprinted from Edinburgh Chronicle, in The Suppressed Documents, or, an Appeal to the Public against the Conductors of the Scottish Guardian (Glasgow, 1836), 12.

ABSTRACT

This study concentrates on the scientific writings of Thomas Chalmers, David Brewster, John Fleming and Hugh Miller. All belonged to the Evangelical party in the Church of Scotland and all joined the Free Church of Scotland at the Disruption in 1843. The thesis begins with a brief history of natural theology between the seventeenth and nineteenth centuries. It also reviews previous work on science and belief in the first half of the nineteenth century, pointing out that much of the emphasis in studies of Christian natural theology has been on the Anglican Broad Church. Chapter two describes the divisions in the Church of Scotland and the events which led to the formation of the Free Church of Scotland. It also indicates the particularly favourable circumstances for Evangelical intellectuals at the start of the nineteenth century by charting the rise and decline of the Moderate party during the second half of the eighteenth. Chapter three documents interactions amongst the four Evangelical scientists and describes their roles in the Disruption and in the formation of the Free Church of Scotland. Chapters four and five trace common threads in their natural theologies and in their views about the reconciliation of science and Scripture. Comparisons are made with opinions expressed within the Evangelical party as a whole. Chapter six describes Evangelical reactions to the dissemination of materialism and deism, concentrating expecially on the activities of George Combe and his circle. Combe's natural theology is shown to have been specially threatening to Evangelicals in the Established Church because of the potency of the Book of Nature metaphor in challenges to the clerical supervision of education. Chapter seven examines similarities and differences in the geological work of Miller and Fleming and examines the role of rival natural theologies in the development of theories about the Earth's origin, history and development. Particular attention is given to the astronomical nebular hypothesis and to the transmutation theory put forward in Vestiges of the Natural History of Creation. Chapter eight summarises the various functions of natural theology for the Evangelicals and for the Combeists.

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PREFACE

'Evangelical' is a term used to describe both religious denominations and parties within denominations. The main focus of this study is on a group which first formed one of the latter and then one of the former. The majority of the Evangelicals in the Church of Scotland left the Established Church in 1843 to form the Free Church of Scotland.

The foreground of this study is occupied by four individuals who travelled this route: Thomas Chalmers, David Brewster, John Fleming and Hugh Miller. They were chosen because they were all actively involved in the events leading up to the Disruption or in the establishment of the Free Church (or both). Their commitment to the Evangelical cause was public as well as private. The other requirement for inclusion was that the individual had written about geology and the development hypothesis. With the possible exception of Chalmers, all were also "serious and productive scientists", a criterion used by Gillispie to select material for Genesis and Geology. Brewster, Fleming and Miller merit entries in the Dictionary of Scientific Biography. Such a condition is, I believe, sufficient but not necessary. Chalmers qualifies for inclusion in the study purely on the strength of having written one of the Bridgewater Treatises. Further justifications for the detailed treatment given to Chalmers' works appear in chapters three and four.

These four figures occupy the foreground but I have ranged widely for the background of Evangelical opinions and attitudes. I have tried to determine what pressures existed on the four scientists within the Evangelical party. To what extent were their views

exceptional? To what extent did they carry other clergymen with them? In order to answer these questions I searched Evangelical newspapers, periodicals, lectures and addresses. Here, I did not confine my attention to geology and the development hypothesis. Many clergymen as well as scientific specialists expressed views on issues such as the origins of the cholera epidemics and the dangers of Combe's Constitution of Man. It seemed essential to include discussion of this material in a study which deals with the role of Providence in the natural order.

On the Constitution of Man, especially, I ranged even more widely to include material by Presbyterian Dissenters. Though evangelical in doctrine, Dissenters frequently differed from the Evangelicals in the Established Church over issues of church organisation. Comparison of their reactions to the Constitution of Man indicates the role of ecclesiastical politics, as distinct from doctrinal position, in determining views about nature. The Dissenters' views are designated 'evangelical' without the capital 'E'. During the period, the Dissenters produced one important scientific writer, Thomas Dick. His influence on religious opinion and reactions to his work are discussed.

In chapters six and seven I devote considerable space to the science and natural theology of George Combe's school, against which the Evangelicals reacted strongly. All the individuals discussed were at some time members of Combe's Edinburgh circle. Biographical connections between individuals in this group are documented in chapter six.

Chapter One

SCIENCE AND BELIEF: CONFLICT AND HARMONY

The relationship between science and religion can be a positive, mutually supportive one rather than one of antagonism. This commonplace of historiography owes much to the scholarship of the past fifty years. In the late nineteenth and early twentieth century, a number of polemical works portrayed the relationship between science and theology as one of struggle and conflict; pure, rational, neutral science was supposed to have freed itself gradually but inexorably from a crushing weight of ecclesiastical oppression.[1] The studies which have helped to create a more balanced picture cover a wide variety of scientific developments from the seventeenth century onwards. Merton has identified certain strands within Protestantism which helped to foster the rapid development of science in the seventeenth century. The argument is that Puritanism encouraged scientific endeavour as a useful, wholesome and morally elevating pursuit.[2] Merton's thesis is closely related to Weber's more general one on the contribution of the Protestant ethic to the development of capitalism.[3] Other studies have concentrated on theological contributions to the content of science. Oakley suggests that the concept of a law of nature originated in the notion of a command issued by God to His Creation.[4]

A vital element in undermining the 'warfare' model of science and religion has been the study of natural theology, the discovery of divine truth by the exercise of man's reason alone. It stems from the fusion of Platonic and Aristotelian philosophies with Christian

teaching in the writings of Thomas Aquinas and other mediaeval scholastics, and found its way into Protestant theology.[5] Even the Protestant reformer John Calvin, who had a particularly low regard for the capacities of unregenerate man, allowed the light of nature a minor role. Its effect was negative only: it left man without excuse before God:

> While experience testifies that the seeds of religion are sown by God in every heart, we scarcely find one man in a hundred who cherishes what he has received, and not one in whom they grow to maturity, much less bear fruit in due season.[6]

A narrower meaning of natural theology concerns external nature only. The world around us is used to prove the existence of a Creator. From it also inferences are drawn about His characteristics. Embodied in this reasoning is the argument from design, which depends for its plausibility on the analogy between the products of human contrivance and natural objects. Natural theology presupposes that design in nature implies the existence of a designer.[7] Although found in the work of some ancient Greek philosophers, the argument assumed fresh importance with the rise of modern science from the seventeenth century onwards. The achievements of Newton, especially, seemed to confirm the view that the creation was orderly, rational and intelligible.

When Robert Boyle died in 1691, his will provided for the founding of a lectureship "for proving the Christian Religion, against notorious Infidels, viz. Atheists, Pagans, Jews, and Mahometans, not descending lower to any Controversies, that are among Christians themselves".[8] Since God had revealed his will both through his word and his works, the lectures drew arguments from both nature and Scripture. Stress was laid on the reasonableness of the

Christian faith, but some lectures, notably those of Richard Bentley, Samuel Clarke and to a lesser extent John Harris, William Derham and William Whiston, popularised the Newtonian philosophy and its theological and social implications.[9]

Though Newton's achievements had been in natural philosophy, any branch of science could, in principle, furnish natural theology with illustrations. Indeed materials could be gathered most abundantly from the living world. Natural theologians emphasised the adaptation of each organism to its environment; popular themes included the means by which animals were able to keep warm and to defend themselves against predators. The provision for man's needs, both utilitarian and aesthetic, was also given prominence. Not only had the Creator provided man with plentiful supplies of food and fuel; He had placed him on a planet abounding in beautiful and varied scenery. Natural theology elevated science to a devout pursuit, unravelling yet further secrets of God's creation. In the eighteenth century, the acknowledged classics of natural theology included the works of John Ray,[10] and William Derham.[11] In the next century, the works of William Paley exerted an enormous influence.

Paley was appointed Archdeacon of Carlisle in 1782. He was also a keen naturalist. Natural Theology (1802) portrayed nature as essentially benign, with scant reference to the Christian notions of sin and redemption. Paley delighted in dwelling on the superfecundity of the natural world, on the sheer quantity of living species which existed within even a tiny area of the earth's surface:

> It is a happy world after all. The air, the earth, the water, teem with delighted existence. In a spring noon, or a summer evening, on whichever side I turn my eyes, myriads of happy beings crowd upon my view.[12]

He viewed man's condition in a similar light:

> ... the prepollency of good over evil, of health, for example, and ease, over pain and distress, is evinced by the very notice which calamities excite.[13]

Much of Paley's work concerned the structure and functions of plants and animals. There were chapters on 'muscles', 'the vessels of animal bodies', 'the human frame', 'comparative anatomy' and 'instincts'. Emphasis was placed on the adjustment of part to part and the compensation for the defects of one part by some other provision. For instance the fixed eyes of insects consisted of multiple lenses pointing in different directions so as to make up for the lack of movement of the eye itself. Paley considered the physical sciences to be less fertile soil for the natural theologian's cultivation, though there were chapters on 'the elements' and on 'astronomy'. The uses and qualities of air, water, fire and light were discussed in relation to the benefits they conferred on living organisms. Similarly the phenomena of astronomy showed evidence of adjustment to earthly needs. The stability of the solar system was not the result of chance; the planetary masses and orbits had been arranged so as to make any irregularities of motion periodic rather than cumulative. Divine design had provided a source of heat and light at the centre and ensured the permanence of the earth's axis of rotation. The figure of the planetary orbits was also important for the survival of living matter, since highly elliptical ones would have carried the planets' inhabitants from regions of intense heat to regions of intense cold and back. However Paley warned that astronomy was not the best means of showing the work of creative intelligence. Its findings were inevitably uncertain.

In 1798, Thomas Malthus' Essay on the Principle of Population provided a picture of the human world which contrasted sharply with Paley's image of nature. Malthus described the suffering inflicted on human populations resulting from a rate of growth exceeding the rate of increase in food supply. Yet he regarded his work as an exercise in natural theology. The discipline imposed on mankind by this seemingly harsh law had led to progress from the savage state:

> I should be inclined, therefore ... to consider the world and this life as the mighty process of God, not for the trial, but for the creation and formation of mind, a process necessary to awaken inert, chaotic matter into spirit, to sublimate the dust of the earth into soul, to elicit an ethereal spark from the clod of clay.[14]

Paley apparently perceived no conflict between Malthus' ideas and his own work, since he included the same principle of population in Natural Theology. It stemmed from the human urge to marry and procreate which "no one would wish to see altered".[15] Paley also emphasised the possibility of social improvement, for which even Malthus held out some hope in later editions of his Essay.

Paley's picture of the natural world was a static one. He opposed the cosmogonical speculations of the French naturalist and philosopher Buffon, who had suggested that the planets might have been struck from the sun. The furthest Paley was prepared to go in discussing origins was to acknowledge that the earth's surface had probably been a compound mixture, part fluid, part solid. The fluid and solid had gradually separated, the Creator having arranged the quantities such that some dry land emerged. Paley's limited attention to geology is not surprising, since it was still an undeveloped science. Indeed, he began his work by drawing a contrast

between the discovery of a stone and of a watch. Whereas the watch contained obvious signs that it had been put together for a purpose, for anything we knew to the contrary, the stone might have lain there for all time.

As Porter has shown, views on the earth's history had been transformed during the eighteenth century.[16] Writers like Thomas Burnet in his Sacred Theory (1681) had portrayed the globe as a deformed chaotic ruin.[17] The punishment which man had suffered at the Deluge could be read in the face of nature. The effects of this appalling catastrophe would be remedied only at the Millennium, when the Creator would purify the earth by fire. The optimistic mood of the eighteenth century brought a new emphasis on order, stability and adaptation.

By the early nineteenth century theories of the earth which attempted a comprehensive synthesis of global and sacred history had almost entirely fallen out of favour. Empirical geology developed rapidly in their place. Biblical chronology indicated that the globe was only about 6000 years old. Geologists demanded immensely longer periods of time, using terms like "indefinite".

To compound the problems with the Genesis account of Creation, the study of fossils accumulated evidence of extinct flora and fauna. Inevitably, geology fell under clerical suspicion. Some geologists attempted to contain the whole of the earth's history within the Biblical chronology. These successors to Burnet, known as Scriptural geologists, were viewed with disdain by the remainder of the geological community.[18] However, some opponents of full-blown Scriptural geology believed that there was geological evidence for the Mosaic Flood.

Gillispie suggests that the main development in natural theology during the first half of the nineteenth century was its accommodation of a dynamic view of nature. He sees geology as the main element in bringing about this transformation. He also emphasises the immense importance of natural theology in British science (especially in geology and biology) before the publication of Darwin's Origin of Species (1859).[19] Important evidence for this claim comes from the Bridgewater Treatises. When the Earl of Bridgewater died in 1829, he left a will requiring that eight scientific authors be selected who could demonstrate

> ... the Power, Wisdom, and Goodness of God, as manifested in the Creation, illustrating such work by all reasonable arguments, as for instance, the variety and formation of God's creatures in the animal, vegetable, and mineral kingdom; the effects of digestion, and thereby of conversion; the construction of the hand of man, and an infinite variety of other arguments ... [20]

May men of science were also clergymen, including Adam Sedgwick, Woodwardian professor of geology at Cambridge and four of the Bridgewater authors: William Whewell (astronomy and general physics), William Buckland (geology and mineralogy), William Kirby (zoology) and Thomas Chalmers (mental constitution and social system).[21]

In view of the key importance which Gillispie attaches to geology, it is worthwhile examining Buckland's treatise in more detail. Buckland offered proofs of divine design in the structure of fossil creatures. He used a kind of calculus of happiness, similar to that of Paley, to justify the existence of carnivorous races. He drew attention to the processes which led to the deposition of coal, pointing out that though the strata had been laid down under deep water, they had subsequently been uplifted, in order to render them accessible. Disturbing forces such as faults and fractures also

aided mining operations. The alternation of porous beds of rock and sand with impervious layers gave rise to springs.

The publication of Charles Darwin's Origin of Species (1859)[22] is seen by Gillispie as the sounding of the death-knell for natural theology.[23] Darwin's theory of natural selection accounted for the diversity of living species in terms of the small variations present in plant and animal populations. He drew evidence from the geographical distribution of species, the variation of plants and animals under domestication, the basic unity of structural type underlying apparent diversity, and the development of embryos before birth. Darwin suggested that a struggle for existence could substitute for the activities of a human breeder and over long periods of time lead to adaptive change.

Historians have paid considerable attention to the debates over the Darwinian theory both inside and outside the scientific community. Inevitably, many of these studies have taken into account the religious and natural theological issues affecting the acceptability of the theory. These are important not only for an understanding of why people accepted or rejected evolution by natural selection. As Cosslett points out, many of the myths about the relationship between science and religion, handed down to us in the twentieth century, were generated in the heat of post-Darwinian controversy.[24] Nearly all accounts rule out the claim that the main conflict on religious questions was over the truth of the Scriptural account of Creation. Study of the pre-Darwinian period virtually eliminates such a possibility even before examining the later debates. Gillispie and others have shown how far some scientists, highly orthodox in their religious beliefs, were prepared to depart from

narrow Biblical literalism, even before 1859. Cosslett points out that, within the Church of England, the controversy over evolution was secondary to the one which took place over Biblical criticism. She suggests that the conflict was not primarily between scientists and theologians, but rather between two different types of scientists. The old-fashioned school, the natural theologians, wished to find meaning, purpose and moral order in nature. The new men, typified by T.H. Huxley, John Tyndall and Darwin himself, sought to free science from such a burden of values and assumptions. Darwin's theory furthered the aims of this second group since natural selection introduced an element of randomness into nature. It subverted the concept of purposive development under the direction of the Creator.

Cosslett's interpretation accords with that of Turner, who emphasises that the separation of science and religion was a social process, the inevitable accompaniment of professionalisation. The 'new men' were not prepared to tolerate clergymen/scientists in the mould of Sedgwick and Buckland continuing to play a dominant role in institutions such as the Royal Society. Representing the group in its most severe of anti-clerical moods, Sir Francis Galton could even deny that clergymen could ever be genuine scientists.[25] Turner acknowledges that cognitive factors also played a part in the rupture. From the 1840s onwards the position of the clerical scientists became increasingly difficult, in the face of developments in geology, biology and physiological psychology.

The view of Gillispie seems to be that the split was inevitable; Sedgwick, Buckland and others had attached themselves to a lost cause, containing within itself the seeds of its own destruction.

The very presuppositions of natural theology provided a licence not only to careful investigators like Charles Darwin but to the speculations of writers such as Robert Chambers.[26] Chambers' Vestiges of the Natural History of Creation, published anonymously in 1844, put forward a theory of development by natural law. Complex forms of life had arisen out of simpler ones as a result of a progressive tendency inherent in living matter. Chambers presented the process as the realisation of a grand creative plan, consistent with the wisdom and foresight of its Almighty Deviser.[27] Though its basic theory was not new, Vestiges upset and angered many members of the scientific elite, including Sedgwick, who spent much time enumerating the book's factual errors. Gillispie suggests that Sedgwick's attack lacked coherence because he actually shared many of Chambers' basic assumptions. When Sedgwick condemned the author of Vestiges for annihilating the distinction between material and moral, he overlooked the fact that orthodox natural theologians were doing something very similar. Sedgwick and his school believed that moral order could be inferred from natural order, and very rarely discussed the reality of spiritual phenomena. According to Gillispie, "truth had first to be found in materials apprehended by sense, and then it had to be "ennobled" into morality."[28] They thus sailed dangerously near to the destructive wind of materialism, sheltering themselves only under a flimsy covering of "supervisory laws". These laws, accounting for the origins of life, were of a wholly different kind from the laws of inorganic nature, and were a vital link between physical creation and the moral jurisprudence by which the Universe was ordered.

Gillispie does not, I believe, do justice to the theology of

Sedgwick's school. William Whewell, for instance, was keenly aware of the limitations of natural theology. Chapter nine of his Bridgewater Treatise stressed the huge gulf which separated the laws of the physical world from those of the moral world. He emphasised "how incomparably the nature of God must be elevated above any conceptions which our natural reason enables us to form."[29] Only Revelation could supply us with ideas of 'grace' and redemption. He also admitted the imperfect nature of the analogy between the works of man and those of God. Only God could be the author of laws regulating the behaviour of objects.

The weakness of natural theology, for a Christian, is precisely the one identified by Whewell. It has nothing to say about the doctrines which uniquely distinguish the Christian religion. To the believer its arguments may afford new dimensions of faith, new grounds for worship and praise to the Almighty. To the sceptic they can serve only as an invitation. Silent about the Christian message of redemption through the suffering of Christ, natural theology contains nothing with which a deist would disagree. Various species of deism had enjoyed considerable popularity in eighteenth century England.[30] In France, the creed became a kind of orthodoxy amongst the philosophes, and the philosophical basis for attacks on the power of the monarch and of the Roman Catholic Church. Voltaire and Diderot held that the universe was a gigantic machine set in motion by its Creator, but requiring no further interference to ensure its harmonious working.[31]

Perhaps some Christian writers in Britain had also succumbed to the seductive appeal of nature and its splendours. Were Paley and his successors offering nothing more than disguised deism?

Dillenberger detects the beginnings of such apostasy in the writings of Ray and Derham. He claims that they inverted the apologetic of earlier writers for whom the glory of God manifested in Creation had been only a subsidiary theme:

> ... in the period under discussion, the domain of nature was divorced from its Christological centre. The heavens no longer declared the glory of God to the eyes of faith. Rather, the heavens were used to argue for the wisdom of a Creator.[32]

This preoccupation with the works of God at the expense of His Word caused natural theologians to be mute about sin and suffering, subjects on which Christian theology could throw some illumination. Even the agonies of the natural world had to be minimised and explained away.

Dillenberger does not, perhaps, give a complete picture of Paley. Other works such as his Evidences of Christianity suggest that his own faith was no lukewarm or half-hearted affair.[33] As we shall see, there were those who claimed parts of his natural theology in support of deism and anti-clericalism. So influential were his writings that all later authors on the subject, whatever their affiliations, acknowledged their debt to him. The difficulty identified by Dillenberger was nevertheless a real one. How was the Christian to secure the domain of natural theology against the incursions of the deists? The question is one raised in the present study.

In reply to Gillispie's view that natural theology collapsed from its own internal contradictions, one can cite instances of natural theologians coming to terms with Darwin's Origin. The Rev. Charles Kingsley, for example, recognised new materials for the design argument in a theory of development by natural causes.[34]

Darwin sometimes used metaphorical language, describing the process as one in which "nature selects"[35] As Young has pointed out, this apparent attribution of intelligence and purpose to nature made it easier for some natural theologians to accept the evolution theory.[36] Darwin himself believed that he had harvested from the pastures of natural theology the very materials of its own destruction. Paley's Natural Theology, with its emphasis on adaptation, is known to have played a significant part in Darwin's intellectual development. Malthus' Essay on the Principle of Population helped the naturalist to develop his idea of a struggle for existence exerting pressure on plant and animal populations. The Origin reconciled the contrasting moods of nature found in the works of Paley and Malthus. Struggle could explain adaptation.[37]

Whether or not Darwin destroyed natural theology, there is general agreement that the subject declined in importance in the second half of the nineteenth century. Young, for instance, has written of the "fragmentation of the common context" of science, natural theology and social theory.[38] In order to understand the reasons for this decline it is sensible to turn the question round and consider the reasons why it was once so enormously important. Briefly, the three functions of natural theology which emerge from the literature are: the defence of scientific pursuits, the defence of religion and the defence of particular views about the social order.

The first function is perhaps the most obvious one and is of particular significance in considering sciences which were prone to attract clerical suspicion. Geology, with its 'indefinite' draughts upon time and its extinct creations, was an example. Gillispie

refers to Buckland's attempts, by means of natural theology and by collecting geological evidence for the Mosaic Flood, to overcome theological hostility to his subject.[39] Rupke in his study of Buckland and the English school of geology similarly identifies features which made it "congruent with and complementary to the tradition of classical learning and which justified its inclusion in the curriculum for the education of the Anglican clergy."[40] The concern with natural theology was one such characteristic.

The second function may seem obvious if we regard it simply as an indication of what certain religious scientists thought they were doing. No doubt a geologist or biologist who was also a fervent Christian regarded his science as a devout pursuit. Natural theology provided him with a language in which to express such a conviction. However, Brooke concentrates on the functions of natural theology as public, rather than private, discourse. He suggests that it served as a mediating influence at a time of religious fragmentation. All could agree on the broad field of natural theology even if they disagreed about doctrine and form of worship. Indeed, natural theology was effective in hiding differences because of the very ambiguity of its formulations.[41]

The third function emerges quite explicitly if we consider works of natural theology devoted to the social and economic system, such as Malthus' Essay on the Principle of Population and Thomas Chalmers' Bridgewater Treatise. However, some historians argue that natural theology, in general, represented a bridge between the natural and the social order. Gillispie suggests that by demonstrating the Providential management of the one, natural theologians provided reassurance that all was well in the other. Young's more recent work

sees Darwin's theory as an embodiment of beliefs and assumptions about nineteenth century capitalism. It carried over its roots in the natural theology of Paley and Malthus.[42] Jacob shows how the Newtonian philosophy was used to support the political and religious establishment in eighteenth century Britain.[43] However, she also demonstrates the role of rival cosmologies, such as that held by the deist, John Toland, in criticising the social order.[44] Gillispie fails adequately to distinguish 'conservatives' and 'radicals' in the nineteenth century. Discussing George Combe, the phrenologist, Gillispie admits that his campaign for secular education "aroused considerable uneasiness in conservative circles." However, Gillispie considers Combe's radicalism to have been limited. Along with "the whole chorus of publicists preaching science to the masses" he "referred its message ... to the ultimate sanction of a providential plan, which shed a more resplendent and commanding light than that of pure naturalism upon the relations of scientist, manufacturer, and mechanic."[45]

Although noting Combe's deism, and the inspiration he provided to Chambers in writing Vestiges, Gillispie plays down Combe's role of social critic. Gillispie's suggestion that Vestiges was a semi-legitimate offspring of orthodox natural theology perhaps leads him to minimise differences between the orthodox school and its deist adversaries. However, Gillispie rightly stresses the importance of natural theology in the dissemination of science. Much evidence for the social and political uses of natural theology comes from studies of mechanics' institutes and other channels of popular enlightenment.

Barnes and Shapin even relate the institutes' frequent emphasis on the more value-free forms of science, such as chemistry and

mechanics, to purposes of social control. They suggest that the move away from overtly value-laden subjects such as political economy was the outcome of a series of experiments in the use of knowledge to guarantee social order. The concern with more impersonal and objective forms of science would make it harder for the working class audience to detect and reject the ideological content of the instruction offered. The avoidance of contentious subjects such as political economy also allowed co-operation in the establishment and running of the institutes amongst individuals holding widely divergent political views.[46]

It is quite plausible that natural theology could fulfil all three functions simultaneously. However, if we can assess their relative importance it will help us to understand the way in which the subject developed and later declined. Much of the emphasis in previous studies of nineteenth century natural theology has been on the Broad Church.

Cannon identifies the Cambridge group which included Whewell and Sedgwick with this party in the Church of England.[47] The characteristics of the Broad Church included a conviction that Christian belief had nothing to fear from the latest fruits of secular learning, be they in science, archaeology or Biblical criticism. The literal truth of Scripture was not the all-important aspect of the Christian faith. The true meaning of Christianity could be glimpsed as much in the ordinary affairs of life as in the pages of Holy Writ. As W.O. Chadwick writes of F.D. Maurice's Theological Essays:

> Do not separate the Bible as inspired from all else uninspired. See the breath of God in common books, in nature and grace, in words spoken to dying men, crashing

through human conflict and comforting human agony.[48]

In order to obtain a wider picture of nineteenth century natural theology, it was felt to be valuable to focus on an entirely different religious group. The Scottish Evangelicals emerged from the literature as an obvious choice. Gillispie singles out the Evangelical geologist, Hugh Miller, for special comment. Distinguishing Miller's critique of Vestiges from those of Sedgwick and others, Gillispie remarks that it was "the only one which impatiently put aside the conventional and arid argument from design as irrelevant." Miller was "a religious thinker who required a divinity rather than a landscape gardener for his God, and whose Christianity centered around the redemption, salvation, and immortality of the soul."[49] Hooykaas similarly claims that Miller's religion was "essentially based upon other grounds than those afforded by the study of nature". Had someone been able "to adduce strong evidence that there were no sudden alterations of type in the organic world, Miller would have acquiesced ... readily".[50]

Other Evangelicals mentioned in the literature of history of science are Thomas Chalmers, John Fleming and David Brewster. Chalmers, a dominant figure in Scottish church history, is noted for his early acceptance of the geologist's 'indefinite draughts upon time'.[51] Fleming, a zoologist and mineralogist, emerges as the enemy of attempts to find geological evidence for the Mosaic Flood.[52] Brewster, a physicist, was an opponent of the undulatory theory of light. Morse suggests that his Evangelical Calvinist beliefs helped to sustain his opposition.[53]

This group appears to have no exact English equivalent. In his treatment of the English Evangelicals, Geoffrey Best remarks that, as

the nineteenth century wore on, they were "increasingly cut off from the institutions and traditions which could have kept them in touch with intellectual and scientific progress."[54] Cannon backs this claim up indirectly in describing the determination of the Cambridge network, "in and if necessary against an increasingly Evangelical society, to champion and advance truth in all departments".[55]

This thesis explores the extent to which Chalmers, Brewster, Miller and Fleming operated as a network in the manner of the Anglican Broad Church scientists. It also tries to determine whether the Evangelicals' attitude to natural theology was different from that of the Anglicans. In view of Calvin's low estimate of the 'light of nature', we might expect the subject to have been of less importance for the Scots. To the extent that they developed a natural theology of their own, how did it differ from its English equivalent? What were its functions? Did it generate a distinctive style of science? Finally, how did the Evangelicals react to the natural theology of other groups: first, that of Christians like Whewell and Buckland; secondly that of deists, including George Combe and Robert Chambers who were also Scottish? The present study attempts to answer these questions.

Chapter Two

MODERATES AND EVANGELICALS

The purpose of this chapter is three-fold. First, it provides an account of the Evangelical party in the Church of Scotland. The conflicts between the Evangelicals and the Moderates which led to the Disruption of 1843 are described. These events formed a vital element in the lives of Brewster, Chalmers, Fleming and Miller. The second purpose of this chapter is to provide a brief account of Scottish intellectual developments in the eighteenth century, concentrating especially on Hume's philosophy and the commonsense school. This is necessary for an understanding of the intellectual development of the Evangelical scientists, especially of Chalmers. The third purpose is to demonstrate the particularly favourable circumstances in which Evangelical intellectuals found themselves at the beginning of the nineteenth century. The chapter therefore examines the rise and decline of the Moderate party. It notes especially the influence of Moderatism on the commonsense philosophy. It also highlights the waning of the Moderates' intellectual prestige at the end of the eighteenth century. Such decline was symbolised by their defeat over the Leslie affair in 1805.

The Disruption sprang directly from a conflict between Moderates and Evangelicals about the rights of congregations.[1] The Moderates supported the institution of patronage, the hereditary right of a landowner, or the right of an organisation such as a town council, to nominate the holder of a living in the Church. Although the Patronage Act of 1712 revived the rights of lay patrons, controversy

could occur over the extent to which a congregation had a say in the choosing of a minister. The difference of view between the two parties was long-standing. Indeed it was in response to two patronage cases which had gone against the presentees that the Moderate party was formed in 1752.[2] The Moderates advocated central as against devolved power, maintaining that the General Assembly had a right to overrule a dissident presbytery or congregation, though this policy later worked against them after they had lost control of the Assembly.

Although they agreed that congregations should have some say in the choosing of ministers, Evangelicals were not of one mind about the extent of this ancient prerogative. One view was that there was a right sanctioned by law and tradition to resist the intrusion of an unpopular presentee, but no right actually to select the minister. The Evangelicals thus became known as 'non-intrusionists'. Some in the popular party went further than this, transforming the demand for a congregational right of veto into a more radical call for the complete abolition of patronage.[3] In 1834, the Evangelicals became the majority party in the General Assembly and carried the Veto Act, which seemed to give the non-intrusionists what they wanted. In practice it led only to head-on collisions between the Church Courts and the Civil Courts, the Civil Courts invariably siding with the aggrieved presentee.

At Auchterarder, in 1835, 286 male heads of families out of 330 opposed the patron's choice of minister. After an unsuccessful appeal to the General Assembly, the presentee obtained an act of declarator from the Court of Session that the Presbytery was obliged to take him for a probationary period. The House of Lords concurred

with this judgement and the dispute reached deadlock, the Evangelicals enraged that the Church's independence of the civil power had been undermined. A further obstacle to Evangelical hopes for a satisfactory resolution of the patronage issue was a challenge to the legality of the Veto Law issued by the Dean of the Faculty of Advocates, John Hope. More legal battles followed at Lethendy in the Presbytery of Dunkeld, where the Presbytery inducted a minister in defiance of the Court of Session, and at Marnoch in Aberdeenshire, where a Moderate-dominated Presbytery was deposed for disobeying the General Assembly and obeying the Court of Session. Unsuccessful attempts were made first by Lord Aberdeen, then by the Duke of Argyll to introduce bills to Parliament which would produce a satisfactory accommodation between the rights of congregations and the institution of patronage.[4] In 1842 the General Assembly adopted a document called 'The Claim of Right' which set out in detail the majority party's grievances over the threat posed by the civil authority to the Church's claim that Jesus Christ was its one and only Head. The die of the Disruption was cast. After nearly ten years of strife, about 470 of the Church's 1200 clergymen decided that they could remain in the State Church no longer. The parting of the ways took place at the General Assembly of 1843, the seceding Evangelical ministers and their congregations forming the Free Church of Scotland. The size of the secession surprised many contemporary observers, and produced a division in the Church which was not repaired until 1929. Indeed, since even then a small fragment did not rejoin the Established Church, it could be said that the effects of the Disruption persist even today.[5]

The Disruption came about because of differences over Church

government, rather than over theology. The patronage issue became enmeshed in the wider question of the degree to which the State Church should be subordinate to the civil power. To the Evangelicals, the Moderates were guilty of Erastianism, allowing spiritual matters to fall under the sway of mere temporal authority. The Moderates believed that the Evangelicals were seeking the benefits of belonging to an Established Church without accepting its attendant responsibilities to Government and social order. Underlying this conflict were contrasting views about the role of the Church in society. These were reflected in earlier debates about aspects of Church organisation. Chapels of ease were additional churches created by private enterprise in urban areas which had rapidly grown in population. The Moderates opposed their establishment on the grounds that they might allow a kind of licensed secession, enabling parishioners to avoid an unpopular minister. The Moderates were also afraid that, without proper regulation, the chapels could become bases for sedition and Jacobinism. In 1798, the General Assembly ruled that the local presbytery had to submit detailed information on a chapel to the Assembly for approval. Missionary societies also fell under Moderate suspicion because they were inter-denominational and might be associated with radical political groups. As a result, the Assembly declined support for missions in 1796.

During the eighteenth century there were some small-scale forerunners of the Disruption. The various secessions were invariably over the question of patronage in relation to the rights of congregations. In 1733, a Commission of the General Assembly voted to suspend the Rev. Ebenezer Erskine amd three other ministers

from the synod of Perth and Stirling. Erskine had vehemently attacked the Assembly's decision that where the patron had not exercised his right of presentation after a period of six months, the choice should be made by the elders and heritors in country parishes and by the elders and town council in burghs. This was instead of an appointment being made by the presbytery, which often took into account the views of the congregation. Erskine and his colleagues formed the Associate Presbytery.

Another secession occurred in 1761, this time over a disputed presentation to the parish of Inverkeithing. Thomas Gillespie of Garnock was singled out for suspension from six members of the recalcitrant presbytery appearing before the General Assembly. The other ministers and their congregations later joined with Gillespie in forming the Relief Presbytery. Meanwhile, the Associate Presbytery had split in 1747 over the legitimacy of the burgess oath, which required acceptance of "the true religion professed within this realm". The two fragments were therefore known as Burghers and Anti-burghers. By 1806 both Burghers and Anti-burghers had divided again over the question of subscription to the Westminster Confession of Faith, the so-called "Auld Licht and New Licht" controversy. The Westminster Confession dated back to 1647 and embodied the Calvinist doctrines of the Scottish Church. Some of the effects of eighteenth century factionalism were repaired when the two "New Licht" groups came together as the United Secession Church in 1820. A further merger, with the more liberally minded Relief Church, took place in 1847 to produce the United Presbyterian Church.[6] All the secession churches were strongly evangelical in doctrine. However, the United Secession, the Relief Church and later the United Presbyterians

differed from the Evangelicals in the Church of Scotland in their strong commitment to the voluntary principle. They stridently opposed the very concept of a State Church and so had little sympathy for the non-intrusionists in their battle with the Moderates.

Were the differences between Moderates and Evangelicals purely over issues of church organisation? Theologically, there was no formal difference between the two parties since all ministers were required to subscribe to the Westminister Confession of Faith. In practice, however, the Moderates tended to set aside much of the emphasis on the Fall of man and salvation through divine grace. They favoured a more polished and elegant style of preaching, stressing the moral qualities of a Christian life. The Evangelicals preferred extemporary discourses dwelling on human corruption and the regenerating power of the Gospel message. Moderatism they regarded as lukewarm and incapable of ministering to man's true spiritual needs.

The Moderates emphasised the need for the Church to involve itself in the intellectual, cultural and political life of the nation. Their support for the policy of pluralism enabled a clergyman to combine tenure of a University professorship with a living in the Church. The historian William Robertson, principal of Edinburgh University, and acknowledged leader of the Moderate party from 1762 to 1780, was the most eminent churchman to manage such a double career.[7] The Moderates tried to meet scepticism half way by making the Church's teaching acceptable to the upper classes and the intelligentsia. Advocating a tolerant approach to theological discipline, they abandoned the doctrinal zeal of the past, in which even minor deviations from orthodoxy had been punished. The emphasis

in their preaching and writing was on the power of reason, the exercise of which was regarded as essential to proper understanding of Scripture. The era of the Moderates, the second half of the eighteenth century was a period of remarkable intellectual activity in Scotland. The array of talent has never been equalled since. While David Hume was pouring forth razor-sharp philosophical discourse, Adam Smith was explaining the merits of free trade in The Wealth of Nations and Adam Ferguson was helping to lay the foundations of sociology.[8] The achievements in the physical sciences matched those in the social. Joseph Black, best known perhaps as the discoverer of latent heat, also demonstrated chemical differences between ordinary air and 'fixed air' (carbon dioxide). William Cullen was a pioneer in medicine, physics and chemistry, theorising about the classification and origins of diseases and laying the foundations of refrigeration technology with his investigations of the cooling produced by evaporation.[9]

In such a small country, it was perhaps inevitable that virtually all the major contributors to the Enlightenment were well acquainted with one another. Many, like Black, Smith and Ferguson, held university chairs but even 'outsiders' like Hume met regularly with the rest in a variety of clubs and societies, mostly in Edinburgh. Binding together their individual achievements was the thread of philosophy. All were interested not only in their chosen fields of study but in the wider questions raised by man and his relationship to society, and the necessary pre-conditions for the advance of knowledge and civilisation.

Historians have put forward a variety of explanations to account for such an extraordinary volume of philosophical, literary and

scientific activity. George Davie has emphasised intellectual nationalism following the Treaty of Union in 1707, with its prospect of Scotland's becoming a mere province of England. Cultural activity promised to preserve a sense of national identity, whilst an interchange of ideas between Scotland and the Continent helped to differentiate Scottish philosophy from English.[10] Trevor-Roper has also discerned the origins of the Enlightenment in contacts with the rest of Europe, but sees this fertilisation taking place not through established institutions like the Church but through a kind of counter-culture of episcopalians, Jacobites, heretics and a new class of educated laymen.[11]

What part did religious influence play in this sudden flowering of the Scottish intellect? Smout has discerned a negative contribution in Scotland's theological past. The relaxation of religious ardour was a mechanism which abruptly released energy for secular pursuits. The resulting economic progress in turn bore cultural fruits. The Enlightenment owed much to the patronage of the landowners, whose prosperity and security had increased, and to the improved economic status of the Lowland middle classes.[12] Campbell ascribes a more benign influence to religion, seeing the Enlightment concern with the transformation of society as an extension of Calvinist ideas about the transformation of the individual, albeit re-stated to accord with the secular values of the eighteenth century.[13] Chitnis inclines to Campbell's view that Calvinist doctrine evolved into the Enlightenment interest in social man. Like Davie, Chitnis also stresses the importance of Scotland's institutions, notably the Church, the universities and the legal system: "The intellectual elite, with a prominent exception in David

Hume, were overwhelmingly either churchmen, lawyers or professors."[14] Even Smout acknowledges that the Church's contribution to cultural development was not wholly negative. The educational system, both at school and university level, was shaped, maintained and modernised by the Kirk.

There is general agreement that a liberalising of Calvinism created a favourable atmosphere for intellectual experiment. Important in reconciling innovative thought with conservative theology was the commonsense philosophy. Its originator is often held to be Francis Hutcheson, professor of moral philosophy at Glasgow University from 1729 to 1746.[15] As Hoeveler suggests, Hutcheson's teaching moved away from the Calvinistic view of human nature in the assertion that individuals were naturally inspired by selfless motives.[16] Yet his Calvinistic inheritance was visible in his emphasis on the need constantly to subdue appetites and passions. True benevolence arose not from the will, which was bound by self-interest, but from an instinctive moral faculty, entirely separate from the human ego. The commonsense philosophy received a kind of negative stimulus from the work of one of Hutcheson's pupils, David Hume. Educated at Edinburgh University, and originally destined for the legal profession, Hume shared with other Enlightenment thinkers an interest in history and the progress of society. In other ways however, he was a lone voice. His philosophy is sometimes presented as one which carries the inquirer from the idealism of Bishop Berkeley into an abyss of hopeless scepticism or even solipsism. Yet, paradoxically, Hume was an empiricist. His aim was to strengthen the philosophical foundations of scientific knowledge.[17] Hume's work achieved greatest notoriety for its attack on the

cherished truths of religion. In his Essay 'Of Miracles', he used a probabilistic argument to cast doubt on the credibility of accounts alleging such violations of nature's laws. Experience taught us that men sometimes lied or were genuinely mistaken. Therefore it was always more probable that the testimony of witnesses was unreliable than that there had been a break in the uniformity of nature.[18]

Such wounding blows at Christian belief might have given comfort to a deist, had not Hume been equally severe in his treatment of natural religion. In the Dialogues concerning Natural Religion, Philo, one of the disputants, denied man's ability to know anything of an external Creator by examination of the universe around him. The analogy between man-made objects and the universe was so imperfect as to be a wholly unreliable basis for such arguments:

> ... in such questions as the present, a hundred contradictory views may preserve a kind of imperfect analogy, and invention has here full scope to exert itself. Without any great effort of thought, I believe that I could, in an instant, propose other systems of cosmogony which would have some faint appearance of truth; though it is a thousand, a million to one if either yours or any one of mine be the true system.[19]

Hume's assault on natural religion derived much of its power from his views on causation. He held that there were two kinds of mental perceptions: ideas and impressions. The latter were matters of immediate experience, such as seeing, feeling, loving and hating. Ideas were less lively perceptions, originating in memory or imagination. All our ideas, however, were entirely derived from impressions. Hume recognised that there were certain truths, such as the propositions of mathematics, which were of a necessary character. There was an absurdity in maintaining, for instance, that three times five was not equal to fifteen. Mathematics, however, was a self-

contained system, whose statements remained valid, regardless of the existence or non-existence of objects in the external world to which they might refer. It was quite different when we made assertions about the real world, where our knowledge of events was entirely the result of experience. There were no propositions within the realm of observation which, without losing their empirical character, went beyond a description of the way something appeared at a particular moment. Thus Hume argued that there was no necessary truth in the assertion that event A was the cause of event B. All we could say was that, as a matter of experience, A was always followed by B. Causality was mere constant conjunction. The notion of power by which A gave rise to B simply expressed the association between A and B in our own thoughts.[20]

The consequences for natural religion were catastrophic. We had no direct knowledge of world-formation. Therefore we could not make any inferences about the Creator of the universe, the only one of which we knew anything at all. Philo voiced the following sceptical sentiments about the design argument:

> When two species of objects have always been observed to be conjoined together, I can infer, by custom, the existence of one whenever I see the existence of the other; and this I call an argument from experience. But how this argument can have place where the objects, as in the present case, are single, individual, without parallel or specific resemblance, may be difficult to explain. And will any man tell me with a serious countenance that an orderly universe must arise from some thought and art like the human because we have experience of it? To ascertain this reasoning it were requisite that we had experience of the origin of worlds; and it is not sufficient, surely, that we have seen ships and cities arise from human art and contrivance.[21]

Hume's philosophy left a trail of desolation. Not only religion but even the notion of causal laws in science appeared to be

devastated. Commonsense philosophers like Thomas Reid aimed at restoration and repair.[22] Reid was a Moderate minister (of New Machar, near Aberdeen) and then professor of philosophy at King's College, Aberdeen before becoming in 1764 professor of moral philosophy at Glasgow University. He and other members of the commonsense school took up the challenge of justifying man's natural beliefs such as belief in an external world, in causality and in moral values.

At the root of the problems in Hume's philosophy, according to Reid, lay the doctrine of ideas. The assumption that the mind could know only ideas, and that these could somehow represent things outside the mind, was inadequate as an explanation of memory, perception and thought. Reid argued that we did not infer the existence of physical objects from our perceptions. Some sensations, such as the roundness of a ball, were immediately intelligible. They were 'natural signs', which, like familiar words, we immediately recognised and understood. Similarly we knew the existence of other men's minds from an untaught language of gesture, facial expression and intonation.

Reid also challenged Hume's analysis of the causal relationship, insofar as it applied to efficient causes. The belief that every event had a cause was a universal one, the denial of which was absurd:

> ... in matters of deep speculation, the multitude must be guided by philosophers, yet, in things that are within the reach of every man's understanding, and upon which the whole conduct of human life turns, the philosopher must follow the multitude, or make himself perfectly ridiculous.[23]

Reid maintained that active power required a subject "endowed with

will and intelligence."[24] Matter was passive and physical science dealt only with antecedents and consequents, with physical causes. Efficient causes belonged to another domain:

> Upon the theatre of nature we see innumerable effects, which require an agent endowed with active power; but the agent is behind the scene. Whether it be the Supreme Cause alone, or a subordinate cause or causes; and if subordinate causes be employed by the Almighty, what their nature, their number, and their different offices may be - are things hid, for wise reasons without doubt, from the human eye.[25]

Hume, in the Dialogues, had suggested that the universe resembled "an animal or organized body". Such a cosmology, in which the Deity was the "Soul of the world" was at least as plausible as any other.[26] For Reid and the commonsense school, the processes of nature were impossible without the constant sustenance of the Supreme Being. Alarmed by Hume's suggestion that reason should be governed by the passions, Reid also defended the objectivity of moral truths. Moral judgements were not mere subjective feelings. To make them dependent only on the constitution of the individual meant that a change in our structure might change virtue into vice and vice into virtue. It would also deprive God of any moral character, since "nothing arbitrary or mutable can be conceived to enter into the description of a nature eternal, immutable, and necessarily existent."[27]

The commonsense philosophy was developed further by Dugald Stewart, professor of moral philosophy at Edinburgh University from 1785 to 1810, who actually disliked the term 'commonsense' and preferred to speak of 'the fundamental laws of human belief'. These basic truths were authorised by reason, not commonsense, since anyone who did not act in the light of such principles would be said to be losing his reason. A fervent anti-materialist, Stewart argued that

we had the same evidence for the existence of mind as we had for matter. Like other members of the commonsense school, he also restored the design argument from the fragments in which Hume had left it. Indeed, Stewart maintained that design was a matter of almost universal belief. It was undesirable to dwell too much on the collection of proofs:

> But it appears to me that the evidences of design in the universe are alike obvious to the savage and to the philosopher; and that they are much more forcibly impressed on the minds of those whose understandings have been perverted by sceptical sophistry, by general views of nature, than by examining her works in detail.[28]

Other commonsense philosophers included James Beattie, professor of moral philosophy and logic at Marischal College, Aberdeen from 1760 to 1797[29] and George Campbell, principal of Marischal College from 1759 until 1796, and also professor of divinity from 1771 to 1795. Author of a highly-praised Dissertation on Miracles in reply to Hume, Campbell was, like Reid, a Moderate clergyman.[30] Later members included Sir William Hamilton, professor of logic and metaphysics at Edinburgh University from 1836 to 1856[31] and Thomas Brown, from 1810 to 1820 conjoint professor of moral philosophy at Edinburgh University with Dugald Stewart. Brown was on the periphery of the school, since he accepted a great deal more of Hume's philosophy, though not its sceptical conclusions on religion. He agreed with Hume that power was a word expressing nothing and therefore accepted that physical and efficient causes were the same. However he maintained that man had an intuitive anticipation that the same antecedents would be followed by the same consequences. This was prior to all experience and afforded an instance of divinely arranged adaptation between man's mental constitution and the

external world.[32]

The commonsense philosophy formed the backbone of Scottish university curricula well into the nineteenth century. In its anti-materialism, its clear separation of matter and spirit, it appealed even to conservative theologians. In its emphasis on man's reason and moral worth it bore the imprint of Moderatism.[33] During the Robertson era the Moderates displayed a remarkable degree of tolerance, which extended even to Hume's metaphysical heresy. Although their numbers were never very large in the Church as a whole, the Moderates were very adept at controlling the General Assembly. Thirty nine out of fifty four Moderators elected between 1752 and 1805 were Moderates. Evangelical anxieties about sceptical tendencies could thus be overruled.

Another dissident metaphysician, the lawyer Henry Home (Lord Kames) was, like Hume, on friendly terms with a number of leading Moderate divines. Starting from the assertion that we had no knowledge of the relation between a physical cause A, and a physical effect B, Kames argued that similarly we had no knowledge of the relation between human intention and the action produced. Both types of causal relationship were on an equal footing. We had no privileged inner awareness of power. Instead of drawing from this a sceptical conclusion, Kames took the action of a human agent as the paradigm for <u>all</u> causation. We could only estimate the force of a power by the magnitude of the effect produced. Collapsing dualism, Kames endowed matter with activity and ridiculed the notion that God continuously preserved all activity in nature.[34]

In the General Assembly of 1755, there was a move by the Evangelicals to condemn both Hume and Kames but it was decided only

to recommend ministers to be vigilant against infidelity.[35] The following year a committee of the Assembly resolved to take no disciplinary action against Hume since it was felt that the Church had no authority over a non-Christian. Hume took the precaution of not publishing the Dialogues concerning Natural Religion, although they circulated freely amongst Moderate clergymen.

The Evangelicals, also known as the popular or 'wild' party, considered the Moderates to be lax in matters of doctrine and discipline. The Evangelicals adhered much more closely to Calvinism with its emphasis on man's complete sinfulness, and his helplessness without the mediation of Christ, effected inwardly by the working of God the Holy Spirit. To know God was not only to know him as the Creator but as the father of men, through the redeeming power of Christ's suffering. Those who were not destined to be united with Christ were doomed to punishment and destruction.[36] Robert Walker, a minister of the High Church in Edinburgh from 1754 to 1783, expressed in one of his sermons the Evangelical estimate of man's condition:

> Surely the heart of man is with good reason said to be "deceitful above all things, and desperately wicked." We are hastening to the tribunal of that Judge, whose eye hath been constantly upon us, and from whose sentence there lies no appeal. No craft or policy can evade his justice, neither can any power deliver out of his hands; yet we live as if we had no witness, no judge, nor any cause of importance to be tried. - God hath assured us in his word, that "death is the wages of sin." Reason condemns it; conscience either remonstrates against it, or rebukes us for it:- yet in defiance of all these, we hug it in our bosom, and refuse to let it go.[37]

Man's sinful nature was beyond the influence of mere exhortation or example. Other differences from the Moderates included the 'popular' party's more punctilious observance of the Sabbath. The Evangelicals also deprecated such promiscuous activities as dancing and the

performance of stage-plays, activities which Moderate clergymen tolerated or even patronised.

An Evangelical caricature of the typical Moderate minister portrayed a man steeped in worldly pursuits, enjoying the society of the heritors but insouciant about parish visiting. On Sundays he would read to his congregation an address elegant in its composition but empty in its spiritual content. This was probably an unfair picture in the majority of cases, certainly an exaggeration, but it was an enduring image, used to great effect in the stormy years which preceded the Disruption. The establishment of chapels of ease reflected a growing concern in the Evangelical ranks that the Church was exerting a decreasing influence over large elements of the population, particularly in the industrial towns. Whereas Moderatism had tried to make religion palatable to the upper layers of society, the Evangelicals feared that it had alienated other sections. Competition for worshippers from the secession churches was worrying enough but, worse still, the working man might remain outside the influence of any church at all. The Evangelicals believed that the presentation of ministers who were congenial to the heritors but remote from the humbler members of their congregations, had encouraged this drift into godlessness. A Free Church historian, James McCosh, later commented that "when the Scottish metaphysicians were discoursing so beautifully of moral virtue, there was a population springing up around their very colleges in Edinburgh and Glasgow, sunk in vice and degradation". Such corruption could not be swept away "by any remedy which the mere philosophic moralists have propounded."[38] What especially appalled the popular party was the extent to which the Moderate view of the world minimised disorder,

suffering and sin. In a satirical catechism of the mid-eighteenth century, John Witherspoon, minister of Beith, poured scorn on his opponents' unqualified admiration for the orderliness and moral perfection of nature:

> I believe in the beauty and comely proportions of Dame Nature, and in almighty Fate, her only parent and guardian, for it hath been most graciously obliged, (blessed be its name,) to make us all very good.
>
> I believe that the universe is a huge machine, wound up from everlasting by necessity, and consisting of an infinite number of links and chains, each in a progressive motion towards the zenith of perfection, and meridian of glory; That I myself am a little glorious piece of clock-work, a wheel within a wheel, or rather a pendulum in this grand machine, swinging hither and thither by the different impulses of fate and destiny; ...
>
> I believe that there is no ill in the universe, nor any such thing as virtue absolutely considered; that those things vulgarly called sins, are only errors in the judgement, and foils to set off the beauty of Nature, or patches to adorn her face.[39]

Although they considered themselves to be defenders of the Church's Calvinist inheritance, the Evangelicals were not indifferent to changes in the society around them. Their leaders differed from the zealots who, in 1696, had been willing to put a young student to death for heresy. In Edinburgh and other cities, if not in the remote country districts, Evangelical divines responded to the altered intellectual and social climate of the late eighteenth century. Douglas Sloan notes the attempt by John Witherspoon to harmonise "Enlightenment rationalism and Calvinist doctrine."[40] Mathieson describes Robert Walker as "a skilful diluter of Calvinism" and observes that there was much greater hostility to polite education from the Secession churches than from the Evangelicals remaining in the Church of Scotland.[41] Nevertheless, the Moderates showed far greater interest in secular learning.

The Evangelicals (and later the Free Church) were strong in the burghs and in the Highlands and weak in the southern farming counties. In the Highlands and Islands opposition to the power of the patrons arose, at least in part, from animosity to the landowners over the clearances. So strong were the Evangelicals in some parts of the Highlands that the Established Church practically disappeared after the Disruption. Maclaren's study of Aberdeen at the time of the Disruption suggests that, in the burghs, the non-intrusionist party was especially attractive to new entrants to the middle class, who, through non-intrusionism, expressed their opposition to a ruling alliance of landowners and old-established merchants.[42] The growing strength of the Evangelicals in the early part of the nineteenth century was no doubt partly due to demographic changes: the growth of industrial cities, particularly Glasgow, and the expansion of the urban middle class. Partly, however, it was due to contradictions which had appeared in Moderatism itself.

After 1780 there was a change in the character of the Moderate party. It had always been identified with the landowning class, an alliance cemented by the Moderates' support for the institution of patronage. However, under Robertson's leadership they had avoided allying themselves with a particular political faction. Robertson himself was a Whig, and while he was at their head, the Moderates supported a number of liberal causes, including the abolition of the slave trade and the movement for burgh reform. Their independent position ended abruptly when Robertson was succeeded by George Hill, principal of St Andrews University. Under his leadership, the Moderates were at the beck and call of Henry Dundas. As Lord Advocate in William Pitt's Tory government, Dundas was effectively

political ruler of Scotland from 1775 until his impeachment in 1805. The French Revolution brought a closure of ranks between Moderates and Evangelicals, as both parties reacted in alarm at the appearance of democratic movements such as the Friends of the People, established in Edinburgh in 1792. The fear of social disorder also led the Moderates to withdraw from any previous flirtations with deistic or radical ideas. In this climate, such Enlightenment products as James Hutton's Theory of the Earth fell out of favour. Hutton was a deist and envisaged that geological change was a cyclical process. One could find in the earth's history "no vestige of a beginning, no prospect of an end."[43]

The waning friendship between Moderatism and Scottish intellectuals was further damaged by the Leslie Affair of 1805. The dispute concerned the election to the mathematics chair at Edinburgh University to fill the vacancy left by the appointment of John Playfair to the chair of natural philosophy. The Moderate-dominated Presbytery of Edinburgh took the exceptional step of exercising its right of avisamentum (advice) and objecting to the Town Council's election of Leslie. The grounds of the Presbytery's complaint was a passage in Leslie's Treatise on Heat which implied his support for Hume's analysis of the relationship between cause and effect:

> ... it [Hume's account] was only wanted to dispel the cloud of mystery which has so long darkened that important subject. The unsophisticated sentiments of mankind are in perfect unison with the deductions of logic, and imply nothing more at bottom, in the relation of cause and effect, than a constant and invariable sequence.[44]

Leslie later explained in a letter that he was concerned only with physical causes and entirely dissociated himself from Hume's philosophical principles where they touched religious matters. The

Evangelicals in the Presbytery then withdrew their objection, but the Moderates insisted that the whole fabric of natural theology was endangered. To deprive the causal relation of the notion of power made it impossible to argue from the evidence of nature to the being and attributes of God.

The Town Council went ahead and elected Leslie in defiance of Moderate objections. The Edinburgh Moderates then referred the matter via the Synod of Lothian and Tweeddale to the General Assembly. In retaliation, the Evangelical minority in the Presbytery lodged a Protest and Complaint against the reference. Leslie also received the support of leading intellectuals such as John Playfair, Dugald Stewart and Thomas Brown. The debate that followed saw both sides squeezing every drop of juice from what was already a rather well-trodden species of metaphysical fruit. Stewart even turned the tables on the Moderates by suggesting that, if power were held to be contained within a physical cause, then the universe was self-existent. They had thrown open the door to atheism.[45]

The Moderates sought to replace Leslie with their own candidate, Thomas McKnight, who was also minister of Trinity College Church. They had made it a condition of McKnight's election that he should retain his parish, and thus the issue of pluralism is one which some historians have picked out as a driving force in the controversy. In Leslie's defence, the Evangelicals questioned the importance of the argument from design which he was held to have challenged. Certainly it was not the only grounds of belief in a Creator, and therefore, even if it were set aside, the Christian could bring forward other arguments. One leading Evangelical, William L. Brown, Principal of Marischal College, Aberdeen, thought that even if Leslie rejected the

argument altogether, he could still conscientiously subscribe to the Confession of Faith:

> For, if he is really persuaded of the existence, attributes, and providence of God, though the grounds of his belief should be different from ours, he may be a sincere Christian, and admit our form and description of Christianity.[46]

Another Evangelical, the Rev Andrew Thomson, went further, defending Leslie's right to reject all the traditional arguments of natural religion, and yet still claim to be "a sound theist."[47] After a heated debate in the General Assembly, the Evangelical complaint was carried by 96 votes to 84 and the Moderate reference thrown out. Although this single issue did not in itself bring about the Moderates' downfall, historians have regarded it as symbolic of the ending of an era.

J.B. Morrell has emphasised the essentially political character of the Leslie affair. His account sees the arguments about causation and design as convenient metaphysical missiles fired by the Moderates in an attempt to have their own man installed in the mathematics chair. They chose a vastly inferior mathematician and miscalculated the degree of support Leslie would receive not only from the Evangelical party but also from the intellectuals.[48] Ian Clark, by contrast, has stressed the importance of the metaphysical issues themselves. He suggests that the Evangelicals found it easier to come to terms with the devastation inflicted by Hume on the argument from design. Hume's work was recognised as the basis for a new beginning in theology, a break with the Moderate emphasis on the proofs and evidences of natural religion.[49] John Burke's analysis concentrates on the distinction between efficient and physical causes as a landmark in the progressive accommodation between the

territorial claims of science and religion. However he fails to notice the different reactions of Moderates and Evangelicals to Leslie's offending note.[50]

In this thesis I examine the extent to which the Evangelical views about natural theology, expressed during the Leslie controversy, were reproduced later in the nineteenth century. This will indirectly throw some light on the issues raised by Morrell and Clark. For the moment it is sufficient to note that, whatever the reasons for the way the Evangelicals behaved, there is no doubt about the public appearance of their position. Possibly for the first time in their history, they were perceived to be taking the side of secular knowledge against ecclesiastical repression. Contemporary observers, such as the lawyer Francis Horner, remarked that this was a striking case of role reversal:

> The description of ministers, who have always proudly avowed a more strict adherence of the peculiar standards of our Church in discipline and faith, while they are still characterized by a predilection for topics of doctrine, and by the more useful distinction of pastoral assiduities, have lost, in a more enlarged education, and a more liberal intercourse with mankind, those feelings of intolerance which disgraced their predecessors; and, in the case of Mr. Leslie, have proved themselves equal to the soundest learning of the times, and true to the great maxims of toleration.[51]

Conversely, John Playfair sought to prove that the Moderates had behaved differently from the way in which their illustrious predecessors like Robertson, John Drysdale and George Wishart, would have reacted.[52]

In 1805, at the beginning of the period under study, the Leslie affair had shown that the Moderate party could not always impose its will on the Church. The party had once delighted in its encouragement of Enlightenment ideas and Moderate leaders had mixed

socially even with the sceptic Hume. The association with 'advanced' ideas was inevitably weakened in the climate of fear created by the French Revolution. However, the dispute over Leslie's election had damaged the Moderates' reputation as metaphysicians and shown them publicly to be at odds with leading intellectuals. Moderatism was clearly in decline. Its commitment to government and social order had come to look as if it existed merely to do the bidding of the ruling party. In the eighteenth century, the Evangelicals had been rather isolated from the main intellectual developments. They would have no truck with pluralism. Indeed, the spiritual fervour of their clergy was such that there was little time for the literary and scientific pursuits which, for some Moderate divines, helped to pass the days between Sabbaths. It is less easy to generalise about the laity. However, it seems plausible to suggest that in such a climate those with philosophical and scientific interests tended to gravitate towards the Moderate party.

The Leslie affair indicated that a new wind was blowing across the Scottish intellectual landscape. The Moderate synthesis of reason and religion was looking decidedly dilapidated. Though the Evangelicals had no finished philosophical system to supplant it, there were signs that they had marked out the foundations of a new structure. The rhetoric of the debates about causation and natural theology should not necessarily be taken at face value. However the exchanges provide clues about what to look for later in the century.

Chapter Three

FOUR CHRISTIAN PHILOSOPHERS

In this chapter I examine the careers of Thomas Chalmers, David Brewster, John Fleming and Hugh Miller. I offer an outline of Chalmers' progress from Moderate clergyman in a rural parish to his leadership of the Free Church of Scotland. Accounts are given of the scientific work of Brewster, Fleming and Miller, highlighting also their involvement in Church controversies and in the Disruption. In Brewster's case, I describe briefly some of the other reforming causes to which he devoted himself during his long life. However, the chapter's main thrust is to show the interactions amongst the four men. I attempt to determine whether they perceived themselves to form a distinctive group amongst men of science. Finally, I consider the question of whether contemporaries recognised them in this way.

Chalmers, the oldest of the four, was born in 1780. The son of a general merchant in Anstruther, Fife, he attended St. Andrews University but also spent two sessions at Edinburgh University between 1799 and 1801, attending the lectures of John Robison (professor of natural philosophy), Dugald Stewart (moral philosophy), John Playfair (mathematics) and T.C. Hope (chemistry).[1] Brewster (b.1781) and Fleming (b.1785) also studied at Edinburgh. Brewster's father was the rector (headmaster) of Jedburgh Grammar School.[2] The future principal went up to Edinburgh in 1793, studying under Playfair, Robison and Stewart and graduating M.A. in 1800. Fleming, the son of a small farmer in Bathgate, went to Edinburgh University

in 1802 and is known to have attended the classes of T.C. Hope.

Brewster had intended to enter the ministry. Licensed to preach in 1802, he gave up this ambition because of his extreme nervousness of public speaking. However, he preached on several occasions in Edinburgh and Leith before returning to work as a private tutor. Chalmers became minister of Kilmany in Fife in 1803. At that time his sympathies lay with the Moderate side and he seems to have spent a large part of his time lecturing on scientific subjects at St. Andrews. Before his ordination he had been mathematical assistant at St. Andrews University. Dismissed on his appointment to the ministry, he opened mathematical classes of his own in the city. He also lectured on chemistry. In 1804, he was summoned before the Presbytery of Cupar after criticism of the amounts of time he was devoting to science. The complaint was quashed. Afterwards, Chalmers treated his own parishioners to a course of lectures on chemistry, repeating them in Cupar.

In 1804, Chalmers was an unsuccessful candidate for the chair of natural philosophy at St. Andrews and, in 1805, he even had hopes of succeeding Playfair in the mathematics chair at Edinburgh. Despite his Moderate sympathies, Chalmers showed no eagerness to support his party's 'official' candidate in the contest. His own contribution to the controversy was a pamphlet defending the mathematical abilities of the Scottish clergy. Written in response to an accusation of Playfair's, it contained the (later embarrassing) claim that "after the satisfactory discharge of his parish duties, a minister may enjoy five days of uninterrupted leisure, for the prosecution of any science in which his taste may dispose him to engage."[4] It was not until about 1810 that Chalmers began to take a more earnest view of

his clerical duties, coinciding with a profound change in the nature of his Christian beliefs. According to his son-in-law and biographer, William Hanna, Chalmers' conversion to an evangelical view of the Gospel stemmed partly from the experience of severe illness and family tragedies. Other factors included his preparations for writing the article, 'Christianity', for the Edinburgh Encyclopaedia.

Fleming went to his first appointment in the ministry at Bressay in Shetland in 1808. In 1810, he moved to Flisk in Fife and, in 1832, to Clackmannan. Throughout his life, he stood on the Evangelical side of the Church. He owed his appointment at Bressay to the friendship that had grown up with members of the local Presbytery while carrying out a survey for the Scottish Board of Agriculture on the economical mineralogy of the Orkneys and Shetlands. After his ordination he continued his scientific work, submitting several papers to the Edinburgh-based Wernerian Natural History Society, including a 'Description of a Small-headed Narwal, cast ashore in Zetland'[5] and a 'Mineralogical Account of Papa Stour'.[6] There is no evidence that anyone in the Church ever criticised Fleming for his scientific pursuits. When he moved to Flisk in 1810, he became a neighbour of Chalmers' until 1815, when Chalmers moved to the Tron parish, Glasgow. Hanna notes that they met on more than one occasion. Chalmers' diary for September 1810 records:

> Had a pleasant scientific conversation all evening; find him a valuable accession in this point of view, but I must keep up with him a tone of seriousness on religious subjects.

Two days later, the diary reassuringly remarks:

> Had a long walk with Mr. Fleming, and am happy to find that he expresses a high sense of duty on the subject of the clerical office.[7]

When a vacancy arose in 1832 in the parish of Auchtermuchty, 400 signatures were collected on a petition in Fleming's favour which was sent to the patron, though to no avail. The parishioners of Clackmannan gathered a similar number of signatures asking him to remain rather than go to Aberdeen in 1834. Nevertheless, Fleming decided to accept the chair of natural philosophy at King's College.

Brewster gave up private tutoring in 1807. After an unsuccessful attempt to secure the chair of mathematics at St Andrews in 1807, he resigned himself to supporting his scientific studies by writing and editing. His first book was a history and defence of freemasonry (1804).[8] British masons had fallen under suspicion after the French Revolution. The Tory, John Robison, was among those who had accused them of harbouring the same subversive designs as their continental brothers.[9] Brewster admitted that, in a Catholic country ruled by an absolute monarch, masonic lodges had become centres for political discussion not truly connected with freemasonry. The very different constitutional arrangements which existed in Britain meant that British lodges were untainted by revolutionary sentiments. The following year, Brewster again took the liberal side in a controversy, in an anonymous pamphlet defending John Leslie against the Moderates.[10] The author's contempt for Leslie's accusers was readily apparent and the pamphlet serves as an early indication of Brewster's Evangelical sympathies.

Brewster's reluctant choice of a literary career had the consolation that it provided a wide circle of correspondents amongst writers and men of science, including Sir Walter Scott, Thomas

Carlyle, James Skene, curator of the library and museum of the Royal Society of Edinburgh, and the Rev. John Lee, later principal of Edinburgh University. Skene and Lee were among contributors to the Edinburgh Encyclopaedia, of which Brewster was the editor. Other contributions came from Chalmers (on 'Christianity') and from Fleming (on 'Conchology', 'Helminthology', 'Hybernation', 'Ichthyology' and 'Insecta'). In 1814, Brewster, along with Robert Jameson, professor of natural history at Edinburgh University, and John Playfair, successfully proposed Fleming for a fellowship of the Royal Society of Edinburgh. In 1819, Brewster, together with the mineralogist Sir George Mackenzie, invited Chalmers to apply for the natural philosophy chair at Edinburgh in succession to Playfair. Brewster was evidently not averse to pluralism, despite his support for the Evangelical party:

> The interests of the university and what is of infinitely greater importance the interests of religion in Scotland depend upon your decision. There can be no doubt of your perfect competency for the situation, and you could easily discharge its duties without abandoning your clerical occupation.[11]

The invitation came at the point when Chalmers was preparing to move to the new church of St. John's, Glasgow, and it annoyed him considerably that Dr Andrew Thomson had led the Edinburgh Town Council to believe that he would accept the chair if he were offered it. He declared afterwards that he had considered doing so if his proposals for the management of the St. John's parish, particularly with regard to poor relief, had been turned down. Chalmers subsequently secured the agreement of the Glasgow magistrates and Town Council to his stipulation that the kirk session should be given control of the funds raised by church-door collections for the poor.

The normal practice was to hand them over to the General Session, a body composed of all the ministers and elders of the City. Chalmers took no further steps to secure the chair, which went to John Leslie.[12]

The population of St. John's parish was almost entirely working class, poverty was widespread and fewer than a third of the inhabitants claimed any kind of association with the Established Church. Chalmers now had the opportunity to put to the test his theories about urban evangelism. He divided the parish into 'proportions', sub-divisions, to each of which an elder was attached to look after the people's spiritual welfare. A deacon was also assigned to each district to take care of poor relief, and in each area a Sabbath school was established. The four years in St. John's were exhausting, but Chalmers claimed success for his 'experiment' to prove that legal provision for the poor was unnecessary.[13] Overwork had injured his health and in 1822 he welcomed an invitation from Dr Francis Nicoll, principal of the United College at St. Andrews, to apply for the vacant chair of moral philosophy.

Chalmers' moral philosophy differed from that of predecessors in the Scottish commonsense school. He was not shy of pointing out the limitations of natural religion in the information it communicated about the Creator and His dealings with mankind. He therefore found "nothing violent" in the transition to the chair of divinity at Edinburgh University, to which he was elected unanimously in 1828.[14] Chalmers remained in the post until the Disruption.

In 1822, Fleming's first major work, The Philosophy of Zoology, was published.[15] During the 1820s, Fleming also contributed articles to the Edinburgh Philosophical Journal, edited by Robert Jameson.

Brewster had been co-editor from 1817 to 1819, but then launched the Edinburgh Journal of Science. Fleming seems to have had a more harmonious relationship with Brewster than with Jameson. Fleming was annoyed especially at Jameson's excessive concern not to offend the Oxford geologist, William Buckland, in the diluvial controversy. From the manse of Flisk, the Scottish clergyman dealt a series of damaging blows to Buckland's attempts to gather geological evidence for the Biblical Flood. Jameson added a number of notes to Fleming's first paper and later Fleming feared that Jameson would leave out the notes relating to a later paper. He confided to his friend, the printer Patrick Neill:

> I have found Dr B.'s [Brewster's] friendship uniform, and kind, and intimate - 'the council's' [i.e. Jameson's] irregular, cold, and distant. As men of science there can be no competition. 'The council' is bolstered up by his professorial chair and the museum. Dr B. stands on a broad foundation of discovery and generalisation. Dr B. has mentioned my name on suitable occasions with respect; the Prof. has erased mine from his editions because it was coupled with Thomson's Annals of Phil.[16]

Further evidence of a close friendship comes from the certificate which Fleming supplied to Brewster in the contest for the Edinburgh natural philosophy chair (1833). Fleming declared that he had known Brewster for "a quarter of century", during which there had been "occasionally much intercourse, and frequent correspondence". The testimonial referred to Brewster's work on the discrimination of mineral species by optical methods, which Fleming had examined in manuscript form, expressed admiration for his "zeal, sagacity and candour" and noted that his early education for the ministry qualified him "in a peculiar degree for directing the minds of the youth to the Creator, who prescribed the laws for the regulation of matter which it is the business of the Professor to explain."[17] In a

review written in 1845, Brewster reciprocated by describing Fleming as "our most distinguished philosophical naturalist ... who has so often stood forward as the champion of Revelation against perverted Science".[18]

Despite being busy with literary hack-work, Brewster was a prodigious experimenter, particularly between 1810 and 1830.[19] In 1813, his first major scientific publication appeared: A Treatise on New Philosophical Instruments.[20] It included an account of his measurement of the refractive and dispersive properties of nearly two hundred substances in connection with the improvement of achromatic telescopes. Investigation of the phenomenon of polarization by reflection eventually led him to enunciate the law that the refractive index of the medium is equal to the tangent of the angle of polarization. The angle now bears Brewster's name. A by-product of these studies was the invention of the kaleidoscope in 1816. Brewster also investigated metallic reflection, concluding that light reflected from metals was elliptically polarized. Research on the optical properties of crystals produced a method of classifying minerals congruent in nearly all cases with the mineralogical categories. He discovered by accident during these experiments that heat and pressure could affect the doubly refracting properties of materials, opening up the new phenomenon of photoelasticity for further study. Interested in improving microscopes and coloured glasses, Brewster embarked in 1821 on the investigation of absorption spectroscopy. This area of research caused him to dissent from Newton's theory of colours, an interesting instance where, as Cantor has shown, he did not slavishly follow the great natural philosopher.[21] His admiration for Newton was nevertheless evident in

two biographies, the first of which appeared in 1831.[22] Another work of a popular nature was Letters on Natural Magic, in which Brewster offered scientific explanations of allegedly supernatural occurrences.[23] The work also struck a blow for Protestant rationalism by discrediting some of the pretended miracles of the Roman Catholic Church.

In the 1830s, Brewster became highly preoccupied with various personal struggles, involving both the undulatory theory of light and his own attempts to obtain a secure post which would enable him to carry on his experimental research. He was a fervent advocate of increased state support for scientists, and, in 1830, upset William Whewell, Master of Trinity College, Cambridge, by his reaction to Charles Babbage's work on the decline of science in England. In the Quarterly Review Brewster lamented that "there is not one man in all the eight universities of Great Britain who is at present engaged in any train of original research."[24] He also put forward a scheme for dividing university chairs, which seemed to imply that university professors were overpaid. Beyond mere clashes of personality between Brewster and Whewell's Cambridge group, one can discern differences of opinion about the role of mathematics in natural philosophy and about the relationship between science and technology. The Cambridge group supported James David Forbes against Brewster in the contest for the Edinburgh chair of natural philosophy in 1833, partly because Forbes would introduce to Edinburgh the use of calculus in physical problems. Cambridge had already become a centre for these techniques, and Forbes' defeat of Brewster has been seen by George Davie in nationalistic terms as a victory for anglicising influences over the "humanistic bias" of Scottish science.[25] Forbes (and Davie)

may have exaggerated the differences between the two candidates over the mathematical issue, but Brewster's defeat by his twenty-three year old protege sharpened his dislike of the Cambridge scientists. In the Edinburgh Review, he assumed the role of a jealous parent in his attack on their influence in the British Association, which Brewster had helped to found in 1831:

> ... the moment that the contingent from Cambridge joined the Association, some scheme seems to have been formed to obliterate its origin, to paralyse its objects ... [26]

Whewell's History of the Inductive Sciences was a fresh provocation to Brewster, containing no references to engineering achievements and minimising the contributions of Scotsmen.[27] As Cantor has shown, another running sore in his relationship with Cambridge was the undulatory theory of light, which Brewster feared had become the established orthodoxy in the Royal Society. After the Society had refused publication of a paper on the composition of polarized light in 1841, he complained to the Whig statesman Lord Brougham that the Society needed reform as it was "in the hands of a Cambridge Faction hostile to all Scotchmen".[28]

Brewster's attempts to find secure employment led him up some strange paths. Perhaps strangest of all was his decision in 1832 to enter the Church of England. Confiding to Brougham that he wanted "some permanent resource before the arrival of age or ill health", Brewster consulted the Bishop of Cloyne, who expected few problems in obtaining ordination in view of his previous preparation for the Church of Scotland.[29] Brewster confessed to Charles Babbage that his poor memory disqualified him for the Scottish Church, where extemporary preaching was favoured by the Evangelicals. In any case he had "never felt that there was any difference" between the two

national churches.[30] This comment is surprising in view of Brewster's Evangelical Calvinist beliefs. In 1833, a family inheritance led him to abandon these plans, despite Lord Brougham's offer of a living.[31] Thanks to Brougham's influence, Brewster obtained a crown pension in 1832 and was made principal of the United Colleges of St. Leonard and St. Salvator at St. Andrews in 1838.

During the 1830s, Brewster contributed regularly to the Edinburgh Review, a periodical whose stance was reformist, Whig and secular. Its party politics may have been congenial enough to Brewster but he was occasionally unhappy about its treatment of religious and ecclesiastical matters. In 1837 Brewster warned the Review's editor, Macvey Napier, of the offence likely to be caused by a hostile article on 'Evangelical Preaching'.[32] However, Brewster was not in sympathy with all the activities of the Evangelical party in the Church of Scotland at this time. During the 1830s, Chalmers was campaigning for 'church extension', attempting to attract Government money to subsidise seat rents so as to make it easier for poor worshippers to attend church. Shortly after his appointment to the principalship, Brewster wrote enthusiastically to Napier about the moral philosophy and political economy lectures of Dr George Cook, a leading Moderate. Brewster noted Cook's opposition to Chalmers' "wild scheme of Church extension" and predicted that "if we had a wise Officer of the Crown in Scotland, he might by Dr Cook's powerful influence in the Assembly place the govt. in a right position with the Church."[33] This rift with Chalmers may have dated back to the 1833 professorial election, when Chalmers had expressed a preference for Forbes.[34]

As Anderson has shown, Brewster's honeymoon period with his St.

Andrews colleagues did not last long.[35] His reforming spirit fell foul of the Tory Moderate establishment there, and by December 1838 he was complaining to Napier of "political bigotry with a vengeance" on the part of Cook, who had opposed sending a deputation to Perth to lobby Mr Fox Maule, one of the under-secretaries of state in Lord Melbourne's ministry, about the state of the college buildings and about compensation claims for salary increases.[36] Anderson points out that many of Brewster's charges of financial maladministration had also been made by Chalmers during his time as professor of moral philosophy. In 1840, Brewster and other liberals, anxious to make the University into a scientific centre, sought to have the chair of medicine turned into a chair of natural history, and to offer it to Fleming. The chair of medicine had been converted into a chair of chemistry for the past thirty years but the recent endowment of a separate chemistry chair meant that the medical one was now a sinecure. Once again, Brewster and his supporters encountered opposition from the Tories and instead the chair was designated an anatomical one, according to the terms of the original deed. Brewster suggested to Napier that this was because Cook's party could not get "a Natural History Tory to equal Dr Fleming."[37] The rift in the Church of Scotland was deepening, and in 1841 Brewster was moved to write to Lord Brougham putting the case for the non-intrusionist party and urging that the Government should legislate to end the current deadlock between Church and civil courts:

> But it will be asked why has the Church come to such a determination? She has done so from the Convictions of Conscience - from an anxiety to extend the proper influence of the People, and secure to them religious privileges already theirs by Statute and by Treaty, and from the still higher motive of supplying them with devoted and faithful Pastors who will watch unremittingly over their Religious,

> their Moral and their Physical wants.[38]

Brewster took part in the procession of seceding churchmen in 1843, and attended every sitting of the first assembly of the Free Church. He was afterwards an elder in the new Church.

Fleming's situation at Aberdeen was never ideal and he had accepted it only after a number of unsuccessful applications for other chairs more closely related to his interests in natural history. To make his lot worse, he was obliged, as the junior professor, to take on a great many secretarial duties.[39] In a letter of 1838, he complained to Charles Lyell of "the system of torture in reference to College matters under which I have now been smarting for 4 years and see no end."[40] Despite these hardships, Fleming continued his favourite studies, contributing the article 'Mollusca' to the seventh edition of the Encyclopaedia Britannica and other papers to the Edinburgh New Philosophical Journal. He was also an active member of the Aberdeen Philosophical Society, formed in 1840. His allegiance to the Evangelical cause remained firm and he was dismayed when his friend, Patrick Neill, sided with the Moderates in the constitutional controversy:

> I regret to observe your present lukewarmness towards the best friends of the church. I never admired the Veto. But I never for a moment doubted the right and power of the church to determine what constituted qualification ... [41]

Unlike the other three, Miller received little in the way of formal education, and never held a university appointment of any kind during his life. He was also considerably younger than the others, born in 1802 in Cromarty, a fishing village north of Inverness.[42] Miller was brought up by his widowed mother, his father, a sailor, having drowned in 1807. He was a wild, unruly boy, but in his teens

acquired a taste for literature. Apprenticed as a stonemason at the age of seventeen, he was drawn to study geology through a fascination with the materials of his trade. His apprenticeship ended in 1822 and he worked for several years as a journeyman mason, travelling all over Scotland and often living in the appalling conditions of the bothies, which he shared with his fellow-workers. During this period he developed his taste for literature and his devout Evangelical beliefs, whilst acquiring a very low opinion of the morals and manners of the working man.[43] By 1834, his poetry and other writing had established his reputation locally to the extent that he was made accountant of a branch of the Commercial Bank in Cromarty. Scenes and Legends of the North of Scotland (1835) combined antiquarian studies with descriptions of the fossils he had found in the local Old Red Sandstone.[44]

Fleming visited Miller at Cromarty during the 1830s and, according to Miller's biographer, Peter Bayne, probably then began his controversy with Miller about the interpretation of raised beaches around the Scottish coast. Fleming denied that they provided evidence of a change in the coastline. The controversy continued for twenty years, surfacing in the Royal Physical Society, an Edinburgh natural history society, of which Miller became president in 1852. Bayne stresses that their difference of opinion did not affect "the cordiality of their friendship."[45] Fleming's description, published in 1831, of the scales of vertebrated animals in the Old Red Sandstone paved the way for Miller's work in that formation.[46] In the Old Red Sandstone (1841), Miller bitterly attacked Dr John Anderson of Newburgh for making misleading remarks about Fleming's descriptions of these fossil fish. Miller noted Fleming's reputation

for "untiring research, philosophic discrimination, and all the qualities which constitute a naturalist of the highest order." He claimed that Anderson, a Church of Scotland minister and author of several geological papers, "extensively appropriated" Fleming's written and spoken remarks.[47] Andrews suggests that Miller's animosity towards Anderson was perhaps intensified by the fact that Anderson was a member of the Moderate party.[48] In the 1830s, Miller began to correspond with other leading geologists, including Louis Agassiz and Sir Roderick Murchison. Aroused by the struggle going on in the Church of Scotland, Miller also took up polemical writing. In two pamphlets he maintained that the Church was being oppressed by the civil authority in the administration of the law of patronage, and called on members of his party to continue the fight within the Church:

> We have already seen one of the Presbyteries of our Church honoured by a public rebuke, and fines and imprisonment hang over another. But the duty of our ministers is not the less clear. They owe it to themselves and to their people, to their country and to their God, that they neither obey this iniquitous law, nor yet quit the establishment. Either alternative involves the ruin of the Church of Scotland;[49]

The pamphlets attracted the attention of leading members of the non-intrusionist party, and in 1840, Miller was invited to edit the newly founded Witness newspaper, which was dedicated to their cause.

Moving to Edinburgh, Miller was brought into the thick of the ecclesiastical turmoil. Though an energetic and eloquent defender of his party's interests, he still found time for geological studies. The Old Red Sandstone initially appeared in serial form in The Witness. It was the first purely geological work from Miller's pen but it was no dry scientific text. He excelled in his ability to

impart to the reader the sense of actually observing the ancient seas, teeming with primaeval forms.

Despite his literary achievements, Miller remained something of an outsider in polite Edinburgh society, set apart by his social origins and perhaps partly by his temperament and mode of dress.[50] Bayne records that he developed few close relationships with leaders of the popular party in the Church, although he enjoyed a "warm friendship" with Chalmers.[51]

Brewster, too, seems to have known Miller well. According to Bayne, they were both regular members of a party which visited the home of a Mr Macgill Crichton, a country gentleman and staunch supporter of the Free Church. In the North British Review (1845) Brewster commended Miller as "an able geologist and accurate observer"[52] and in a later issue (1850) described him as:

> ... one of the few individuals in the history of Scottish science who have raised themselves above the labours of an humble profession by the force of their genius, and the excellence of their character, to a comparatively high place in the social scale.

Brewster noted with approval "the high tone of philosophy and religion which distinguishes all his writings."[53] The physicist contributed an account of the geologist's career which was incorporated by Louis Agassiz in a posthumous edition of Miller's Footprints of the Creator.[54] In Footprints, Miller had described Brewster as one of "the first men of the age".[55]

In the Church struggles, Miller was one of the leading lay combatants on the Evangelical side. Chalmers was the undisputed leader of the party during the Ten Years' Conflict which ended in the Disruption. Elected Moderator in 1832, Chalmers presided over a debate in the General Assembly on the patronage issue. A move to

remit to a committee demands for modifying the rights of patrons and restoring the importance of the congregational call was defeated. Two years later, the Evangelicals having secured a majority in the Assembly, Chalmers successfully moved the Veto Act. In its wake came the string of legal battles between Church courts and civil courts. Throughout the conflict, Chalmers' leadership restrained the more radical elements in his party who favoured breaking with the Established Church. As an ardent defender of the Establishment principle, Chalmers regarded such an outcome as catastrophic.[56] However, by early 1843, even Chalmers was abandoning hopes of a negotiated settlement and, once convinced of the need for Disruption, he set about ensuring that the new Church would be able to survive. Possessed of shrewd business skills as well as being a fine orator, Chalmers drew up detailed plans for the Church's organisation and finance in time for the fateful General Assembly of May 1843.

The Disruption undoubtedly strengthened the links amongst members of the group. A distinction must be made between links which they themselves perceived and links which were imputed by others. In the first category, the sense of belonging to a Church born out of persecution probably encouraged a sense of solidarity. Such an attitude was intensified by the manner in which the surviving Established Church revived the ecclesiastical tests, requiring holders of posts in schools and universities to subscribe to the Westminster Confession of Faith. In the seventeenth century, these regulations had been intended to exclude Jacobites, and by the nineteenth century they had long been regarded as an anachronism. The Moderates, especially, had set little store by them in the past, but after the Disruption the remainder of the Established Church

seized on them as a convenient means of removing Free Church schoolmasters and professors from their posts.

One early victim of this new intolerance was Brewster. In July 1843, the University of St. Andrews resolved to send to the Secretary of State for the Home Department a memorial noting that the principal of the United College had "joined himself to a hostile body of dissenters and had thereby in the opinion of the University disqualified himself from remaining Principal of the College".[57] In a letter to Brougham, enclosing a copy of the minute, Brewster saw it as the University's retribution for his exposure before the Royal Commission of "the system of illiterate instruction" at St. Andrews and of the misappropriation of Bursary Funds.[58] The Established Church eventually decided in 1845 not to proceed with its attempts to get rid of Brewster, technically because he had not signed the formal Deed of Demission but largely because of the unfavourable public reaction.

Fleming, too, became worried about his university position after the Disruption. He wrote to Chalmers in August 1843, proposing a three year curriculum in natural theology, covering physical science, biology and zoology, to be taught in a Free Church College in Edinburgh:

> I need not expatiate to you on the influence which such a course would exercise on the minds of the students of the Free Church, or the power of pulpit illustration which it would furnish. Multitudes do not see God in his works because they are not qualified to read the book of nature.[59]

Chalmers wrote back to Fleming: "Sir David [Brewster] and I both exceedingly admire your scheme of a professorship."[60] After a meeting between Chalmers and Fleming in September 1843, a shorter

simplified course lasting one year was agreed upon.

At the Disruption, Chalmers and the Rev. David Welsh had resigned their chairs in the divinity faculty at Edinburgh University, and 93 of the faculty's students had joined the new Church. The Free Church clearly needed a theological college and a building for this purpose was purchased in July 1843. Chalmers became principal and professor of divinity. Work began on a larger building on the Mound in 1845.

There were some in the Free Church who hoped that the College could be developed so as to challenge the main University, offering instruction in other subjects besides theological ones. The Church went some way in this direction. At the Inverness Assembly of the Free Church in August 1845, it was agreed to appoint Fleming to the New College natural science chair. Fleming joined Chalmers and Miller in Edinburgh and remained in the post until his death in 1857. He taught a blend of natural history, natural theology and apologetics. The course also included 'Biblical science', which illuminated Scriptural passages making use of natural imagery.[61] Fleming himself described his subject as "Natural History with its applications to Theological Studies & the Arts of life".[62] A regulation of 1848 required that all Free Church theological students attended the natural science class for one session. The Free Church also created chairs of logic and metaphysics and of moral philosophy at the College. However, the expense of maintaining the non-theological chairs soon led Church leaders to have second thoughts. In 1850, the Free Church majority on the Town Council presented P.C. MacDougall of the moral philosophy chair to the equivalent chair in the University. Alexander Campbell Fraser, professor of logic and

metaphysics, followed him into the University in 1857. Fraser defeated James Frederick Ferrier, who had also been the candidate against MacDougall, and both contests took place in a strongly sectarian atmosphere.

George Davie, from an anti-Evangelical perspective, sees the release of religious enthusiasm in the wake of the 1843 events as a destructive influence. Evangelical commitment to the non-intrusionist principle had repercussions at the philosophical level, the recognition of the right of private judgement, even the judgement of the untutored peasant, resulting in a metaphysics of "unverifiable illuminations and uncommunicable inspirations".[63] This led to an unprecedented degree of polarisation in the commonsense school of philosophy. The intuitionalists - MacDougall, Fraser and the Evangelicals - positively relished its inability to account for man's commonsense beliefs, for which their antagonists, led by Ferrier, sought a completely "rational elucidation".[64] Discouraged by their defeats at the hands of the Evangelical extremists, the Ferrier camp subsequently abandoned commonsense to the intuitionalists and espoused a priori German metaphysics.

In the long term, the Disruption may have had a secularising influence on Scottish life. For instance, the problem of catering for the needs of all religious denominations - Church of Scotland, Free Church and Dissenters - eventually resulted in an Act of 1861 which greatly reduced the Church of Scotland's control over the parish schools.[65] In the short term, however, the schism increased sectarian divisions. Even Davie admits that the Free Church was not entirely responsible for this state of affairs, since the way in which the Established Church used the Test Acts was regrettable.

As early as 1835, Chalmers had confessed to Fleming that he saw no justification for restricting non-theological chairs to communicants in the Church of Scotland.[66] The abolition of the tests now became a liberal cause in which Free Churchmen could join Presbyterian Dissenters and Episcopalians. Fleming was convener of a committee formed in Edinburgh to campaign for such a change[67] and in 1845 Brewster led a deputation to the Prime Minister, Sir Robert Peel, on the subject.[68] An Act of Parliament of 1853 eventually removed the restriction on Dissenters.

Influenced by the lack of support they had received as non-intrusionists from the liberal periodical press in Scotland, Free Churchmen also established their own quarterly, the North British Review. Founded in 1844 by Edward F. Maitland, the Rev. David Welsh, and others, the Review was described by Hanna, as being "pure and independent," and having a "Christian yet unsectarian aim."[69] It aimed to counter-balance the secular tone of its rival, the Edinburgh. The North British was edited first by Welsh, then by Maitland and from about 1847 to 1850 by Hanna. Just after his son-in-law took over, Chalmers issued a circular letter soliciting additional subscribers for a journal

> ... which while universally cognisant of Literature and Science in all their branches, proposes that one of its departments should be specially consecrated to the interests of our common Christianity.[70]

Brewster was a regular contributor on scientific, educational and philosophical subjects. The Review carried 76 of his articles between 1844 and 1863, Chalmers contributing a further seven, Fleming three (or possibly four) and Miller two.

I have already presented evidence of common causes in which the

group laboured after the Disruption. I have indicated their increased personal interactions in the few years after 1843 in which all four were still alive. Brewster's daughter, Mrs Gordon notes that the Disruption events strengthened the early friendship between Brewster and Chalmers. The Free Church leader was a guest at St. Leonard's College, preaching "while there was yet neither Free Church nor pastor at St. Andrews."[71] Chalmers died in 1847.

Miller was urged to apply for the chair of natural history at Edinburgh in succession to Robert Jameson in 1853 but instead Edward Forbes was appointed. Interestingly, although he favoured dividing the chair, Fleming deprecated an attempt to split it into a geological part (for Miller), leaving all the rest for another professor.[72] This was because such a division did not correspond to Fleming's view of natural history, which dismissed geology as too vague a term and held the important division to be between the inorganic and the organic. Mineralogy dealt with the inorganic, zoology with the organic, including the study of fossil life (palaeontology). There was evidently no personal animosity to Miller involved. Indeed, Sir Charles Lyell recalled with pleasure the many geological excursions he had made about Edinburgh with Fleming, Miller or both, during a visit of 1855.[73] After Miller's death, Fleming assisted his widow, Lydia, in preparing for publication the woodcuts in Miller's Testimony of the Rocks.[74]

By the late 1840s, Miller's physical health was seriously impaired, partly by the rigours of his early life and partly by the pressure of editing the Witness throughout the years of upheaval in the Church. In 1845, tired and afflicted by the silicosis which was a legacy from his days as a stonemason, Miller visited England. An

account of his tour was published as First Impressions of England and its People.[75] In the 1850s his mind, as well as his body, began to show signs of illness. He became obsessed with the possibility that he might be attacked and took to carrying a loaded gun whenever he went out. He also began to suffer from terrifying visions. In December 1856, after a particularly horrific experience of this kind, he wrote a farewell note to Lydia and shot himself.

Fleming died the following year. Thanks to his efforts, the chair of natural science at New College survived the removal of the other non-theological chairs and indeed was retained after his death.[76] Brewster lived on until 1868. Although the University and the local Presbytery were unsuccessful in ejecting him, his abrasive temperament led him into further clashes with his academic colleagues at St. Andrews. His decision to raise the Bursaries question before the Royal Commission investigating the Scottish Universities, together with an attack he made on Adam Anderson, professor of natural philosophy, over a gas explosion in the lecture room, prompted William Spalding, professor of logic and metaphysics, to lament to John Lee in 1846 that there was "nothing but wrangling and slander before us."[77] Brewster also continued to complain, in letters to Lord Brougham, and to Charles Babbage, about Cambridge domination of the Royal Society[78] and about attempts by "certain parties" to obstruct the aims of the British Association.[79] Another grievance arose from the choices made by Lord Palmerston's government for presentations to professorial chairs in the gift of the Crown and the general neglect of St. Andrews by Whig administrations:

> Their appointments to our Chairs have been base jobs, during the last 20 years, and their refusal to maintain our University in terms of the Treaty of Union, and to pay

> claims admitted by themselves and one half of which was paid by the Tories, is a proof among many others ... that they are not friendly to our educational Institution.[80]

In 1859, the Edinburgh Town Council appointed Brewster principal of Edinburgh University in succession to John Lee. He remained in the post until his death in 1868, his introductory addresses at the opening of sessions being amongst his last publications of any kind.

According to Mrs Gordon, Brewster's own Christian beliefs deepened during the 1850s, partly as a result of his first wife's death in 1850. Before that, his commitment to the Evangelical cause had been formal rather than personal. In particular, he had doubts about the possibility that anyone could know that he or she was one of the elect. Mrs Gordon records that a profound change occurred in her father's religious outlook during this period. Such a development came too late to have much effect on Brewster's relations with the other members of the group. However, besides their own perceptions of a distinct identity, there are signs that, in the late 1850s, others also began to link the four names. Acknowledged in society as leading men of science, they could be picked out by Free Church apologists as proof that the Church was abreast of scientific developments. The Rev. John Duns, Fleming's biographer and also his successor at New College, connected their names in an article of 1858, by which time three of the four were dead:

> Generally, it will be found that great men come in groups. They are God's gift to any nation; and when He sends them thus, we should rejoice in them - see only their outstanding excellencies, and try to hide that in them by which "poor human nature" testifies that all such treasure is in earthern vessels, that the excellency may be seen to be of God ... Scotland might be lawfully proud of such a group of men, whose scientific labours are associated with her Christianity, as that which contains the names - Thomas Chalmers, Hugh Miller, John Fleming and David Brewster.[81]

Duns again made the link in his biography of Fleming, though for an unknown reason he deleted the reference to Miller. The other three were praised for the service they had rendered to "Christian thought, and generally to the interests of the Church" amongst those "whose discoveries led to speculation of a peculiarly delicate and difficult kind."[82] It obviously suited the Free Church to have them recognised as Free Church scientists before all else.

This chapter has shown the high degree of interaction amongst members of the chosen group. Approximately contemporaries, the four men knew one another for most of their lives, meeting and corresponding regularly. Their various relationships may have differed in intimacy and certainly Brewster seems to have been rather estranged from Chalmers during the 1830s. However, he never deviated from a firm commitment to the cause of non-intrusionism. Their careers differed considerably. Only two were ordained clergymen and only Chalmers could be described as a theologian. Of the other three, Miller and Fleming worked in similar areas of science, though Fleming perhaps looked rather disdainfully on Miller's narrow range of scientific competences, refusing to recognise geology as a discipline in its own right. Brewster also frequently wrote popular articles about geology and overlapped with Fleming's mineralogical interests through his studies of the optical properties of crystals. Brewster was involved in an enormous number of personal and political battles. Opposition to the undulatory theory of light does not seem to have been of particular interest to the other three. On the other hand, Chalmers and Fleming shared his concern for university reform, including his enthusiasm for establishing additional professorial chairs.

The Disruption of 1843 brought the four closer together, both in their own eyes and in the eyes of others. This was partly because 'Free Churchman' was a more clearly-defined and recognisable category than 'Evangelical' had ever been. Moreover, the antagonism of the Civil Courts before the Disruption and the continuing enmity of the Established Church bred a feeling of solidarity amongst all Free Churchmen. The revival of the Test Acts was a particularly blatant instance of intolerance. The Disruption also gave birth to other institutions besides the Church itself. The founding of New College, in particular, helped to confirm a feeling of academic as well as ecclesiastical, separateness, even though the goal of a Free Church University was soon abandoned. However, probably the strongest influences in uniting the group were extraneous to the events in the Church. These are discussed in chapters six and seven. In the next two chapters I examine the extent to which common threads run through the natural theologies of Chalmers, Fleming, Brewster and Miller.

Chapter Four

THOMAS CHALMERS

In this chapter I discuss the development of a discourse about natural theology in the writings of Thomas Chalmers. Although Fleming was also a clergyman, Chalmers was the only member of the group to hold chairs of moral philosophy and divinity. He was also the only one to write works of a purely theological nature. We should therefore expect to find in his writings a keen awareness of the relationship between natural theology and other branches of theology. In view of the breadth of his interests and his central position in the Evangelical party and the Disruption, it seems appropriate to discuss his thought in detail before considering the work of Fleming, Brewster and Miller. Chalmers can perhaps be expected to offer the richest insights into the role in Evangelical thought played by natural theology, and the strongest clues about the interests which shaped its development.

As we have already seen, Chalmers entered the Church with few of the theological or pastoral concerns to which he later committed himself. His father, according to biographers, regretted his son's lack of seriousness about his application to a career in the ministry and in the early years at Kilmany Chalmers' scientific interests frequently took precedence over pastoral duties. This tendency to neglect parish visiting earned the Moderate party a great deal of opprobrium from the Evangelical side, particularly in the years leading up to the Disruption. After the change in the character of his own faith, it was condemned with as much fervour by Chalmers as

by any other Evangelical. The change in his theology was somewhat more complex. Most of his early theological and philosophical mentors survived the conversion process. As Rice has emphasised, in his Moderate period Chalmers was greatly impressed with the reality of God's power.[1] This element remained in his new faith but it was augmented by an awareness of other important aspects of the divine character. To Chalmers the Evangelical, God was a moral governor and a judge as well as being the great Architect of Creation.

As a student in St Andrews Chalmers had been drawn for a time to the optimistic anarchism of William Godwin. Godwin's main work, Political Justice, envisaged a process of perpetual and inevitable social improvement. The goal was a decentralised democratic society founded on reason and the power of private judgement.[2] The writings of the Puritan divine Jonathan Edwards freed Chalmers from the materialism of Godwin, but as Hanna stresses:

> ... his was a different kind of faith from that of Edwards. It was but a philosophical faith in the godhead - a faith resting as its main, if not only support, on enlarged and sublime conceptions of a universe throughout the whole of whose immutable successions a sovereign principle of fixed and unvarying order reigns. A faith soaring so high, and leaning only on such support, was liable to be shaken.[3]

More serious than the effect of Godwin's thought on Chalmers' faith was the result of reading Baron d'Holbach's System of Nature.[4] This work, in which blind necessity replaced the notion of a universe governed by its Creator, reduced Chalmers to a state of philosophical scepticism. Deliverance came in the work of two major figures of the Scottish philosophical school. Chalmers recalled long afterwards the beneficial effects of reading Beattie's Essay on Truth and of attending John Robison's natural philosophy lectures at

Edinburgh University.[5] After his conversion to Evangelicalism he retained his respect for the commonsense school and its achievements, though, as Rice points out, he constantly emphasised its limitations.

Chalmers also carried over his scientific interests, in geology, chemistry and mathematics, although pastoral duties assumed priority over lectures. Poor relief, too, was an early concern which continued to animate Chalmers throughout his life. Finally, Chalmers retained from his Moderate phase a robust defence of geology's freedom from the burden of Biblical literalism. In 1804 in a lecture on chemistry at St Andrews he rebutted charges of infidelity made against the fledgling science:

> By referring the origin of the globe to a higher antiquity than is assigned to it by the writings of Moses, it has been said that geology undermines our faith in the inspiration of the Bible, and in all the animating prospects of immortality which it unfolds. This is a false alarm. The writings of Moses do not fix the antiquity of the globe. If they fix anything at all, it is the antiquity of the species. It is not the interest of Christianity to repress liberty of discussion.[6]

This mode of disengaging the geological record from comparison with Genesis became known as the interval theory since it assumed that an indefinite interval had elapsed between the first and second verses of chapter one. The creation described in the rest of the chapter was only the most recent of a whole series. From a moral and theological point of view it was the only one of any importance, since it culminated in the appearance of man. In 1814, Chalmers gave the theory wider currency in a review of Cuvier's Theory of the Earth for the Edinburgh Christian Instructor:

> Should the phenomena compel us to assign a greater antiquity to the globe than to that work of days detailed in the Book of Genesis, there is still one way of saving the credit of the literal history. The first creation of

> the earth and the heavens may have formed no part of that work. This took place at the beginning, and is described in the first verse of Genesis. It is not said when this beginning was.[7]

While Chalmers appeared to reject narrow Biblical literalism here, he also rejected the tactic adopted by some geologists of fitting the globe's entire history into the Mosaic chronology. The so-called Scriptural geologists attempted to placate clerical opinion by claiming that geology confirmed Moses. Chalmers suggested that if Scripture were properly interpreted then geology did offer such confirmation, but he was also asserting the independence of science from pre-conceptions about the Biblical timescale. "We are not afraid when the torch of Science is lighted up to look at the Bible", he later told theology students at Edinburgh University.[8] In a lecture delivered in 1835 he admitted difficulties with the interval theory, such as the apparent creation of the sun, moon and stars on the fourth day, according to the Mosaic account. The word 'made' must be understood there to mean 'made visible', Chalmers suggested. Even with such problems, Chalmers declared that the geological issue was "altogether an affair of outposts; and that, however decided, it will not affect the main strength of revelation."[9]

If Chalmers had no time for simple formulae linking Genesis to geology, what methods was he prepared to countenance for drawing theological conclusions from his many scientific interests? The argument from design had satisfied the educated minds of the eighteenth century, despite the lacerations inflicted by Hume. Would it satisfy a man like Chalmers, whose faith was of quite a different character from the religion of reason which had dominated Scottish intellectual life in Hume's time? Ian Clark has noted the Evangeli-

cals' willingness during the Leslie affair to set aside the design argument, and has taken it to be part of a more general disaffection with the eighteenth century emphasis on the reasonableness of Christianity. The Moderates, he suggests, were dedicated to the gathering of natural evidence, and to the working out of proofs. Evangelical intellectuals, on the other hand, were prepared even to come to terms with Hume in the quest for a new basis for their faith.[10] Clark is right to note these differences, but they were perhaps exaggerated in the heat of party strife surrounding Leslie's election. We have already noted in chapter two the contributions of the Evangelical, William Brown, to the Leslie debate. However, in his Essay on the Existence of a Supreme Creator (1816) Brown showed no sign of any coldness towards the argument which the Moderates claimed Leslie had undermined. The design argument sat alongside other evidence of the being of God from metaphysics, the human mental constitution, the character of the Scriptures and "the almost universal Assent of Mankind to this opinion":

> The order and beauty of the world, the admirable contrivance of every part of its structure, exhibited to our view, and the exquisite harmony of the whole system, loudly proclaim an invisible, infinitely intelligent, and almighty Creator. The invisible things of God, from the creation of the world, are clearly seen, being understood by the things that are made.* This argument, as it has the greatest weight with the most solid and acute philosophers, is also calculated to bring conviction to every capacity.[11]

Chalmers does seem to have shown some alienation from the notion that Christianity was to be judged by the test of reason. Published early in 1813, Chalmers' article 'Christianity' for the Edinburgh Encyclopaedia seemed to make a very low estimate of the reliability of human judgement by setting aside the internal evidence of Christianity and concentrating entirely on the external. It dealt

only with the evidence external to the Bible for the truthfulness of its contents: its reliability on historical matters, the testimony of original and subsequent witnesses and the fulfilment of Biblical prophecies. It left out the accordance between Bible teachings and our existing knowledge of God and His attributes.[12] In a letter to his friend Dr Charles Stuart, Chalmers declared that he could not believe that "any antecedent knowledge of ours as to the ways of God entitles us to sit in judgement upon the subject of any message accredited by those external proofs, which are a sign to those who do not believe."[13] The article was reprinted as The Evidence and Authority of the Christian Revelation and an advertisement explained that the author was "far from asserting the study of the historical evidence to be the only channel to a faith in the truth of Christianity."[14] Nevertheless, Chalmers' harsh words about the internal evidence were, with some alterations, retained:

> We hold by the total insufficiency of natural religion to pronounce upon the intrinsic merits of any revelation, and think that the authority of every revelation rests exclusively upon its external evidences, and upon such marks of honesty in the composition itself as would apply to any human performance.

Chalmers claimed in his justification not only the sinfulness of pronouncing upon the method of the divine government but opposition to "that theorising a priori spirit, which the wisdom of Bacon has banished from all the schools of philosophy."[15] The work attracted the wrath of a Moderate divine, Duncan Mearns, who accused Chalmers of making common cause with atheists by undermining the conclusions of natural theology. Mearns argued that reason exercised within its proper province was indispensable to revelation and could not be blamed for extravagant, false systems:

> The leading principle which forms the foundation of the reasonings here subjected to examination is, - that all conclusions of a theological nature which are drawn from other sources than divine revelation, are fallacious. Hence it follows, that from the known character, or tendency of a religious system, we are incapable of forming any judgement respecting the validity of its claims to divine authority.[16]

Chalmers' work did not represent his mature view on the subject. In his later (1836) work on the Evidences of Christianity he modified the passage quoted above to read:

> We hold by the insufficiency of nature to pronounce upon the intrinsic merits of any revelation, and think that the authority of every revelation rests mainly upon its historical and experimental evidences, and upon such marks of honesty in the composition itself as would apply to any human performance.[17]

Chalmers now maintained that the line between internal and external evidences was blurred. For instance it was usual to classify any evidence for the truth of the miracles in the New Testament as external, even though the most powerful evidence could, Chalmers argued, be gathered from within the Gospels. Chalmers included in a substantial section on the internal evidences the moral excellence of the Gospel teachings. Further support came from the harmony between the Bible's teachings on the one hand and on the other the felt state of the human heart and the felt wants of our nature. Chalmers drew attention to the believer's experience of a change in mental state allowing perceptions of new correspondences between the state of the human heart and the Gospel message. This enlightening process was a distinct category of evidence.

Works on the evidences of Christianity must be distinguished from works of natural theology, concerned solely with knowledge of divine truth which can be obtained without any reference to Scripture. Of more direct relevance to the investigation of

Chalmers' attitude to natural theology are the Astronomical Discourses, preached in 1816. The professed object of the sermons was to combat an objection to Christianity arising from the notion that other worlds besides our own might be inhabited by intelligent creatures. If this were true, a sceptic might ask, how could the Christian notion be accepted of God's sending his son to free mankind from sin?

The first discourse entitled 'A Sketch of Modern Astronomy' revelled in the sheer vastness of the known universe. The most recent discoveries of the telescope served to strengthen the words of the Psalmist about the magnitude and splendour of the heavens:

> But no human fancy can summon up a lively or an adequate conception - can roam in its ideal flight over this immeasurable largeness - can take in this mighty space in all its grandeur, and in all its immensity - can sweep the outer boundaries of such a creation - or lift itself up to the majesty of that great and invisible arm, on which all is suspended.[18]

Chalmers emphasised that the solar system was probably only one of many myriads of stars surrounded by planets and asked whether it was credible that "the great Architect of nature" would create such "stately mansions" only to leave them unoccupied.[19] The listener was left stunned at the awesome scale of the Creator's domains, and aghast at the earth's physical insignificance:

> The universe at large would suffer as little, in its splendour and variety, by the destruction of our planet, as the verdure and sublime magnitude of a forest would suffer by the fall of a single leaf.[20]

The second discourse, 'The Modesty of True Science', warned of the dangers of speculative science. Chalmers held up Newton as the shining example of an inquirer guided by the light of evidence. There was a warning for those who made unwarranted claims to possess

knowledge of remote regions of space. Unbelievers had no basis for the assertion that Christianity was unknown in other worlds:

> How are they able to tell us, that if you go to other planets, the person and the religion of Jesus are there unknown to them? We challenge them to the proof of this said positive announcement of theirs.[21]

The third disclosure - 'On the extent of the Divine Condescension' - harked back to the first. Chalmers attempted to reassure listeners disturbed by the immensity of creative endeavour described in the opening discourse. To redress the balance he emphasised God's care for minute details of His Creation. Our own experience testified that God was not oppressed by the continued care of human affairs. There were therefore no grounds for believing that a multiplication of His responsibilities would make any difference. Indeed if he were preoccupied with the management of other worlds, we should see signs of neglect in our own. There was also a valuable addition to man's common experience. The discoveries of the microscope, invented about the same time as the telescope, matched those of the other instrument:

> The one led me to see a system in every star. The other leads me to see a world in every atom. The one taught me, that this mighty globe, with the whole burden of its people and its countries, is but a grain of sand on the high field of immensity. The other teaches me, that every grain of sand may harbour within it the tribes and the families of a busy population.[22]

The first and third discourses reconciled the plurality of worlds doctrine with a belief in God's continued superintendence of earthly affairs. There remained the problem, for the Christian, of the particular circumstances of the crucifixion and resurrection of Christ. Why had these events occurred on such a small insignificant planet and what was their relationship with the moral constitution of

other worlds? The question had only been partially dealt with in the second discourse. For a full defence of the theology of Revelation, Chalmers perhaps broke with the strict limits on theorising which he had set in the second discourse. However, in his remarks in discourses four and five about the activities of the inhabitants of other worlds, he claimed Scriptural rather than scientific warrant. There were many places in the Bible where indications were given of "the deep interest and feeling amongst other orders of created intelligence" in the process of human redemption.[23] Chalmers suggested that mere size was an unimportant measure of the battle that was being fought between good and evil here on Earth. He hypothesised that other planetary inhabitants might be in a state of "frequent and familiar intercourse with God", as man was before the Fall.[24] Although he did not dogmatically assert that the Earth was the only foothold gained by Satan, the implication clearly was that vast regions of the Universe remained in a state of innocence:

> I know not if our rebellious world be the only stronghold which Satan is possessed of; or if it be but the single post of an extended warfare, that is now going on between the powers of light and of darkness. But be it the one or the other, the parties are in array, and the spirit of the contest is in full energy, and the honour of mighty combatants is at stake; and let us therefore cease to wonder that our humble residence has been made the theatre of so busy an operation, or that the ambition of loftier natures has here put forth all its desire and all its strenuousness.[25]

David Cairns has taken issue with the suggestion that the Discourses were a major work of natural theology. Rather, says Cairns, they were an exercise in apologetics, in clearing away an obstacle to Christian belief.[26] My own view is that they served a number of different purposes. There is no doubt that Chalmers was tackling the problem of the Earth's special position in Christian

eschatology contrasted with its apparent astronomical insignificance. In the preface, he admitted that the objection did not occupy "a very prominent place in any of our Treatises of Infidelity."[27] However, it was often met with in conversation. This rather specialised purpose seems inadequate to explain why Chalmers took the trouble of composing six discourses on the subject. There were, after all, many other intellectual challenges to Christianity which enjoyed at least as wide currency in society.

A careful reading of the Discourses suggests that Chalmers had other concerns which complemented rather than undermined the central one. Although not a conventional treatise on natural theology, the work is infused with the spirit of natural religion. First, the language is characteristic, with references to "stately mansions", "the great Architect of Nature" and similar expressions.[28] Secondly Chalmers actually recommended the pursuit of natural theology in the first discourse:

> It is truly a most Christian exercise to extract a sentiment of piety from the works and the appearances of nature. It has the authority of the Sacred Writers upon its side, and even our Saviour himself gives it the weight and the solemnity of his example.[29]

This suggests that he regarded astronomy as a potential ally, rather than a mere infidel weapon to be rendered harmless. Thirdly, in discourses four and five, Chalmers' emphasis on the earth as a lone outpost of evil in the universe may have been partly motivated by the concerns of natural theology. If myriads of other worlds were peopled with angelic beings then the apparently vast burden of sorrow, sin and misery which was borne by mankind became minute in cosmic terms. The problem of evil, a difficulty for the natural theologian, was lessened by being localised. Despite the ability of

Calvinism to come to terms with sin and punishment, Chalmers may not have been immune to the appeal of such astronomical theodicy. In a later sermon he isolated the Earth even more emphatically in a reference to "a wide disruption between the planet in which you dwell, and the rest of God's unfallen universe."[30]

Finally, Cairns' argument makes little sense of the sixth discourse, entitled 'The Slender Influence of Mere Taste and Sensibility in Matters of Religion'. This stressed the distance between a feeling of spiritual elevation and a genuine revolution in human character. Chalmers contrasted the transitory effect upon a listener of a beautiful piece of religious music or of an eloquent discourse with the permanent results of true conversion. Cairns suggests that this discourse did not have "very much to do with the main theme of the course".[31] My treatment of the discourses reunites it with the others. It brought the listener back to Earth, both literally and metaphorically. Qualifying the natural theological material in the previous discourses, it reminded the listener of his sinful and rebellious nature, a matter of more immediate and personal concern than the glories of astronomy. While natural theology could arouse the spirit, it could not bring about a permanent change in a person's life. Only revelation could supply man's deepest spiritual needs.

If the role of natural theology in the Astronomical Discourses is contentious, there is no disagreement about its presence in Chalmers' Bridgewater Treatise. Between the preparation of the two works, Chalmers had moved from the ministry in Glasgow to academic life: first the chair of moral philosophy at St Andrews University and then to the chair of theology at Edinburgh. For three years in

the St John's parish he had also had the experience of evangelical work amongst the poorest classes. Chalmers' ideas about pauperism and its moral and spiritual solutions are embodied in the Bridgewater Treatise. Its subject - the relationship between external nature and the moral and intellectual constitution of man - was not the most familiar territory for natural theologians. Chalmers' interpretation of the term 'external nature' to include the behaviour of other human beings, including the phenomena of the social and economic system, placed his work a considerable distance from the genre made popular by Paley. His approach to moral reasoning in natural theology represented a further break with the Paleyan tradition. Paley had emphasised the harmony and benevolence of organic nature. In so far as he dealt with man and his condition, he had minimised pain, disease and suffering. Chalmers not only viewed the human world in a different way. He denied that the world of non-human nature enabled any reliable conclusions to be drawn about the moral qualities of its Creator:

> There may be as thorough an impress of skill and energy on a machinery of torture, as on some bland and beneficent contrivance that operates a blessing throughout the sphere of its activity - on the structure, for example, of a serpent's envenomed tooth, as on the structure of those teeth which prepare the aliment for digestion and subserve one of the most useful functions of the animal economy. It is thus that a wicked and malignant spirit could give decisive, but most terrible demonstration withal of his Natural Attributes - so that these on the one hand may be most strikingly and satisfactorily evinced, while the Moral Attributes on the other may be involved in the mystery of those contradictory appearances in nature, which the wisdom of man has so vainly endeavoured to unravel.[32]

With this image of nature, the human world, rather than offering an awkward or even ugly contrast to the rest of Creation, actually rescued the natural theologian from moral nescience. Indeed, the

Creator could be shown to possess other moral qualities besides the benevolence so much beloved by "slender and sentimental theists".[33] His righteousness could be proved by the phenomena of human conscience and by examining the origin of the suffering which apparently detracted from His benevolence:

> ... in our own species at least, both these enjoyments and these sufferings are mainly resolvable into moral causes - insomuch that, in the vast majority of cases, the deviations from happiness, can be traced to an anterior deviation from virtue; and that, apart from death and accident and unavoidable disease, the wretchedness of humanity is due to a vicious and ill-regulated morale.[34]

Hanna records Chalmers' dissatisfaction with the "low and inadequate views" of both Paley and Thomas Brown on the moral attributes of God.[35] Chalmers' more substantial image of the Creator's ethical virtues could be justified by the observed facts of human conscience. Here the Scottish cleric acknowledged the benign influence of another of his theological mentors, Joseph Butler (Bishop of Durham 1750-52) whose assertion of the supremacy of conscience represented the first "full and reflex cognizance" of the doctrine.[36] If God were not a righteous Being Himself, Butler and Chalmers argued, He would not have implanted in man such an authoritative and recognisable voice in favour of righteousness. Despite acknowledging elsewhere that there was "no author who has not expressly treated of revelation, whose mental philosophy suggests so many accordances between the science of mind and the subject-matter of Christianity",[37] Chalmers censured Thomas Brown for leaving the moral sense to compete with many other mental principles. According to Chalmers, conscience was a single ruling power which controlled, or rather should control, all other human tendencies:

> Neither is the mechanism of Man's personal constitution

> fully or adequately described, by merely telling us in succession the several parts of which it is composed - as the passions, and the appetites, and the affections, and the moral sense, and the intellectual capacities, which make up this complex, and variously gifted creature. The particulars of his mental system must not only be stated, each in their individuality; but the bearing or connection which each has with the rest - else it is not described as a system at all. In making out this description, we should not only not overlook its relative place among the other feelings and faculties of our nature. That place is the place of command. What conscience lays claim to is the mastery or regulation over the whole man.[38]

Chalmers maintained that when conscience was removed from this commanding position "there must be a sensation of painful dissonance; and the whole man feels out of sorts, as one unhinged or denaturalized".[39]

The operation of conscience was a matter of immediate observation, demonstrating that God's kindness to His creatures was to be balanced against His hatred of wrong-doing. Chalmers brought a similar rigour to the method of reasoning from aspects of the natural world. In the introduction to the Bridgewater Treatise he distinguished between the laws of matter and its "collocations" or detailed arrangements. The latter were not explicable by laws alone and, if destroyed, could only arise again with the Creator's intervention. Crosbie Smith has pointed out that this distinction followed John Robison's classification of knowledge, which separated natural philosophy (the science of successive nature, of laws) from natural history (the science of contemporaneous nature, of collocations)[38]. Chalmers claimed it was the tendency of "atheistical writers" to reason only on the laws and to overlook these detailed arrangements:

> It is not so much in the establishment of certain laws for matter that we discern the aims or the purposes of intelligence, as in certain dispositions of matter, that

> put it in the way of being usefully operated upon by the laws.[41]

The greater the number of means combined to produce a beneficial end, the greater the argument for the divine wisdom. Chalmers, however, went further than merely separating laws from collocations. He suggested that if the dispositions of matter could be shown to follow from a single law of nature, then the force of the design argument was weakened. For instance, if the construction of the solar system could be referred only to the law of gravitation, it improved the prospects for an explanation of its origins in terms of chance or necessity. Chalmers suggested that anatomy was a happier province than astronomy for the natural theologian:

> ... nothing on the other hand can exceed the force and concentration of that proof, which is crowded to so marvellous a degree of enhancement within the limits of the anatomical system.[42]

Later in the introduction, Chalmers qualified the remarks which implied that general laws could undermine design. He accepted that laws could contribute to the proofs of design, although to a very much smaller extent than collocations. Moreover, a reduction in the number of separate means combined to produce a particular end might reduce the direct evidence of God's existence, but provide evidence of His character, and so indirectly of his existence. The law of tides might not have been discovered to be an instance of the operation of the law of gravitation, and we might have considered tides to be the result of a distinct natural power or principle. The knowledge that they were an instance of the action of gravitation did not undermine natural theology because the secondary law was an instance of the primary one operating in a new situation:

> And this holds of all the useful secondary laws in the

> material world. If they cannot be alleged in evidence for the number of beneficial principles in nature they can at least be alleged in evidence for the number of nature's beneficial arrangements. If they do not attest the multitude of useful properties, they at least attest the multitude of useful parts in nature; and the skill, guided by benevolence, which has been put forth in the distribution of them.[43]

Physical laws themselves were thus admitted to be "useful", and therefore legitimate objects of study for the natural theologian. The same was true of mental phenomena. The law of taste might be shown to be deducible from some other mental principle, such as our admiration of moral excellence. This simply transferred to the external world what had previously resided in mind:

> If it be not by the implantation of a peculiar law in mind, it is at least by a peculiar disposition of tints and forms in external nature, that He hath spread so diversified a loveliness over the panorama of visible things;[44]

Chalmers even admitted a difficulty of an opposite kind to the chance/necessity problem. There was "a certain transcendental mystery" surrounding the reasons for the Deity's choice of complicated combinations of means to achieve particular ends in Creation.[45] God could have made an atom to possess all the powers of thought and feeling instead of a being as complicated as man. There was no answer to this question to be found in natural theology. The general policy of the divine government was inscrutable.

As John Durant has pointed out, when Chalmers turned from the natural to the social world, his separation of laws from collocations was not at all clear.[46] He set society apart from man, holding it to be a divinely-constructed mechanism which could only be disordered by human interference:

> It is thus that every attempt for taking to pieces, whether totally or partially, the actual frame-work of society, and

> reconstructing it in a new way or on new principles - is altogether fruitless of good; and often fruitful of sorest evil both to the happiness and virtue of the commonwealth.[47]

Yet society was composed of human beings: fallen creatures who were fallible and selfish. Chalmers would not allow that it was a man-made product. Was it, then, a collocation, brought together by the Creator out of many different components? If so, the laws governing the individual components would be insufficient to account for the structure and functioning of the whole. Chalmers did not explicitly answer the question. Rather, he argued that society was subject to laws of its own, to which individuals should conform for their own good. Thus social laws were both the specific principles of a divinely-assembled mechanism and universal standards of moral behaviour. Their dual nature was especially important to demonstrate to the labouring classes, whose fecklessness and periodic social disorder was a matter of great concern to Chalmers. In his St John's ministry he had sought to tackle the first and to some extent the second by an intensive campaign of house-visiting and by a thorough investigation of every claim on the church's poor relief fund. Relief was granted only when all other possible sources of help, such as relatives and neighbours, had been ruled out.

In his treatise on Political Economy and in the Bridgewater Treatise, Chalmers provided the intellectual rationale for his stern social gospel. It was important to emphasise the moral dimension of political economy:

> ... the greater resulting lesson is - the intimate alliance which obtains between the economical and the moral; insomuch, that the best objects of the science cannot, by any possibility, be realized, but by dint of prudence and virtue among the common people.[48]

Chalmers urged that workers should save during periods of high wages so that they might slacken off or even stop working altogether during times of slump. The vagaries of the economic system were thus transformed into machinery of moral training and discipline. Equally unbending was the Malthusian law of population. Thomas Malthus had maintained that population, tending to increase geometrically, would always tend to outstrip food supply, which at best would only grow arithmetically. Natural checks would prevent the unrestrained growth of populations, epidemic diseases usually intervening to forestall the final sanction of famine. Malthus' theory in its earliest form was negative and pessimistic in character. He had allowed a limited role for moral restraint in controlling population growth, although even its exercise he held to be attended with suffering.[49] As Robert Young has pointed out, Chalmers adapted Malthus' theory so as to emphasise the blessings which would follow obedience, as well as the penalties resulting from transgression.[50] To Chalmers, the exercise of moral restraint was a positive benefit, following from "a higher taste for the comforts and decencies of life among the population themselves".[51] Such refined tastes made for later marriages, leading in turn to smaller and fewer families, fewer men looking for work, and, as a result, higher wages. Like Malthus, Chalmers was vehemently opposed to the legal provision of poor relief, condemning the English system and later opposing its extension to Scotland.[52] One of Chalmers' main opponents was the physician and social reformer, William Alison, the battle eventually being won by Alison when a law of 1845 introduced compulsory provision to Scotland.[53] Sometimes portrayed as a heartless defender of the worst excesses of Victorian capitalism, Chalmers is represented more

sympathetically by Saunders as a man trying to apply the values and remedies of eighteenth century agrarian society to a new industrial and urban culture. He perhaps failed to appreciate the enormity of the problems produced by the cycles of economic expansion and recession and by the breaking of family and social bonds resulting from migration from the country into the towns.[54]

In Chalmers' laws of society, the juridical and the descriptive senses of the term 'laws of nature' came together. The law of Malthus and the other social doctrines which Chalmers enunciated were indications of "a natural jurisprudence, founded on the constitution of the human mind."[55] Unlike the laws of astronomy, they bore marks of the moral character of their author, and therefore could safely be used by the natural theologian without risk of opening the door to chance or necessity. Thus Chalmers' distinction between laws and collocations was, in practice, rather less important than at first it might have appeared. Although Chalmers dismissed a natural theology of unqualified divine benevolence, there was much in the Bridgewater Treatise also to temper his social pessimism and to bring him closer to Paley. Universal Christian education provided "a guarantee for the progressive conquests, and at length the ultimate triumph, of good over evil in society". After a few generations, it might reclaim "the degeneracy of the species" enabling Chalmers to contemplate "a brilliant moral perspective for the ages that are to come."[56] The labouring classes were offered the prospect of a particularly large improvement in their condition:

> Their economic is sure to follow by successive advances in the career of their moral elevation; nor do we hold it impossible, or even unlikely - that gaining, every generation, on the distance which now separates them from

> the upper classes of society, they shall, in respect both of decent sufficiency and dignified leisure, make perpetual approximations to the fellowship and enjoyments of cultivated life.[57]

As with the Astronomical Discourses, Chalmers ended the Bridgewater Treatise with a chapter on 'The Defects and Uses of Natural Theology'. Even without lengthy reflection on the subject, the human mind must accept the possibility of God's existence. What was immediately visible by the light of nature showed us we had a duty to inquire more deeply into the question. On the other hand, natural theology alone could not supply man's most vital needs. It could arouse the unbeliever but it could not satisfy the sincere truth-seeker:

> We hold that the theology of nature sheds powerful light on the being of a God, and that, even from its unaided demonstration, we can reach a considerable degree of probability, both for His moral and natural attributes. But when it undertakes the question between God and man, this is what it finds to be impracticable. It is here where the main helplessness of nature lies.[58]

Natural theology was not to be seen as the foundation of Christianity, since Christianity rested "on its own proper evidence". However, Chalmers accepted that natural religion was of "great actual importance", indeed "indispensable" because it prompted the student to seek a remedy for his moral condition.[59] The remedy came from a higher theology in the mediation between God and man performed by Jesus Christ.

Chalmers reiterated his total opposition to systems of natural theology which lessened the chance of arousing the inquirer, by concentrating exclusively on the divine benevolence. A passage from Adam Smith's Theory of Moral Sentiments, removed from later editions of the work, showed Smith's initially correct views on divine

justice. Chalmers regretted his subsequent apostasy, perhaps under the influence of Hume:

> It is no reproach against our philosophical moralists, that they have not stepped beyond the threshold of that peculium, which is strictly and appropriately theirs; or not made incursion into another department than their own. The legitimate complaint is, that, on taking leave of their disciples, they warn them not, of their being only yet at the outset or in the prosecution of a journey, instead of having reached the termination of it.[60]

Notes, unfortunately undated, taken on Chalmers' theology lectures at Edinburgh University confirm that he simultaneously valued natural theology and admitted its limitations. Indeed the lectures tended to dwell more on the unanswered questions and to emphasise more strongly the contrast between the condition of Man and that of the rest of Creation. Natural theology was excellent in putting to flight the anti-theist but

> no man can be carried further than a state of neutrality according to the Baconian philosophy.[61]

Man was left in the same state as the recipient of a gift from an anonymous benefactor. Just as there was a duty to seek out the identity of the donor of the gift, so there was an injunction to find out the duties which rebellious Man owed to his Creator. Natural theology was unable to prove the immortality of the soul and indeed one of its "great Mysteries" was death. Chalmers nevertheless urged on his theological students the usefulness of natural religion in preaching:

> The existence of the impression of a duty awakes the Peasant & the Savage to the preaching of the Minister & Missionary, & leads them to give a favourable hearing. Natural Theology is the Church calling Bill to the Peasantry. The internal evidences are the grand thing that leads on the Peasant to religion.[62]

Chalmers later revised his view of the argument for the

immortality of the soul, including in his Institutes of Theology two separate proofs antecedent to any Revelation. The first was drawn from the harmony observed to subsist between mental capacities and the opportunity for their exercise. Man possessed longings for higher truths, appetites which he could not hope to satisfy during his brief spell on Earth. To hold that his desires could remain unsatisfied even after death was to deny the adaptation which everywhere was perceived in the natural order. The second and stronger proof was uttered by the voice of conscience in our anticipation of the day of retribution. We expected to be punished for our sins after death. In a future state we could also expect the injustices of the present world to be put right.[63]

Chalmers later expanded the Bridgewater Treatise into a volume entitled Natural Theology (1835). There are some interesting differences from the earlier work, particularly in relation to the law/collocation distinction. Chalmers suggested that 'disposition' was a better term than 'collocation' and he included in its meaning the magnitude and direction of motion as well as the size, shape, proportion and location of matter. Properties of matter, on the other hand, were in the same category as laws, inadequate on their own to establish design:

> All the forces, whether of mechanics or of chemistry, or even of physiology, might have been inherent in the various substances of nature: and yet in the random play of all these physical energies, nothing still but a chaos might have emerged, that gave no indication whatever of a presiding mind, which directed the principles and the processes of this immense universe, to any one end or object that mind can be conceived as set upon.[64]

Nevertheless, the magnitude of these properties constituted a necessary, though not a sufficient, condition for organisation:

> ... were all the other dispositions of our present actual economy to remain, a mere change in the intensity of these forces would be the occasion of many grievous maladjustments.[65]

For instance, were man to retain his existing muscular strength, he would be seriously inconvenienced by a tenfold increase in gravitational attraction.

This slight alteration of view on the law/collocation issue suggests that Chalmers had continued to consider the question since writing the Bridgewater Treatise. If he had ever felt that laws of nature were not the concern of natural theology (and I have shown that this is doubtful), he clearly no longer thought so. Indeed he praised the distinction between the force of a law and its intensity or rate in Whewell's "truly admirable" Bridgewater Treatise.[66]

Whewell's Treatise dealt with astronomy and general physics, sciences which had proved successful in explaining phenomena in terms of mathematical laws, such as the inverse square law of gravitation. It is perhaps not surprising to find that such laws figured prominently in the Treatise. For Whewell, the laws themselves indicated wise choice on the part of the legislator who had enacted them. They were selected so as to form a coherent system, implying that they possessed a certain inevitability.

> ... astronomy and meteorology are parts of natural philosophy in which we may study the order of nature with such views as we have suggested, in which we may hope to make out the adaptations and aims which exist in the laws of nature, and thus to obtain some light in the tendency of this part of the legislation of the universe, and of the character and disposition of the Legislator.[67]

Whewell stressed that laws could indicate adaptations either in the form of the laws themselves or in the amount of some "arbitrary magnitudes" which they regulated.[68] Indeed, some of his instances of

adaptation no doubt gave Chalmers considerable pleasure because they showed how astronomical phenomena, such as the length of the day and the year, were adapted to the constitution of plants and animals. Similarly, the laws of heat, together with the arbitrary magnitudes determining the rates of conduction and radiation, governed climatic conditions, upon which the survival of all living matter delicately depended. Here Whewell was tracing divine design, not in the laws themselves, but in the adaptation between laws and collocations. However, the philosophy of his work differed sharply from the principles laid down by Chalmers. Whewell had a strong conviction that man could discover and understand the laws of nature as a result of the harmony which prevailed between the human mind and the divine intelligence. A chapter of the work dealt with the inference which could be made from a law to a designing mind:

> We cannot then represent to ourselves the universe governed by general laws otherwise than by conceiving an intelligent and conscious Deity, by whom these laws were originally contemplated, established, and applied.[69]

Moreover, the existence of a natural order was powerful evidence for the existence of a corresponding moral order. Although analogies could only be uncertainly drawn,

> ... the contemplation of this admirable relation of the arrangements of the physical creation, and the perfect working of their laws, is well calculated to give us confidence in a similar beauty and perfection in the arrangements by which our moral relations are directed, our higher powers and hopes unfolded.[70]

In Whewell's work, then, law implied a law-giver and the existence of natural laws strongly suggested the existence of moral laws.

More surprising than his admiration for Whewell's Treatise was Chalmers' apparent approval of a work by the engineer and mathematician Charles Babbage. Babbage wrote an unofficial Ninth

Bridgewater Treatise which diverged even further than Whewell's from Chalmers' position. The Treatise was prompted by a remark in Whewell's book which Babbage read as a suggestion that those deeply immersed in the study of the mathematical sciences were ill-qualified to discourse on natural theology. Babbage set out to show not only the groundlessness of this belief, but also the truth of its opposite. Scientists who had carried furthest the process of generalisation made the best natural theologians:

> The larger the number of consequences resulting from any law, and the more they are foreseen, the greater the knowledge and intelligence we ascribe to the being by which it was ordained.[71]

Babbage complained of ventures in natural theology by misguided people insufficiently versed in scientific knowledge. In the interests of religion, they had

> ... endeavoured to discover proofs of design in a multitude of apparent adaptations of means to ends, and ... represented the Deity as perpetually interfering, to alter for a time the laws he had previously ordained, thus by implication denying to him the possession of that foresight which is the highest attribute of omnipotence.[72]

Babbage cited the example of his own calculating engine, in which an apparent change in the sequence of numbers, which might suggest some intervention by a human operator, could in fact be explained by a more general law built into the machine at its construction. It is perhaps surprising to find the following passage in a letter from Chalmers thanking Babbage for a copy of the Treatise:

> I think all the more favourably of your work, that it does not appear to me to overbear the argument grounded on the distinction between the Laws and Dispositions of Matter. Even your own calculating machine could not, on the strength of laws alone, have evolved its marvellous results, without those collocations and that adjustment of part to part in the primary construction of it which a

profound intelligence alone could have devised.[73]

Here Chalmers seems to be suggesting that natural laws were the result of dispositions. The laws of the calculating machine's operation were, for Babbage, analogous to the laws of nature. They illustrated how regularity could be reconciled with novelty. For Chalmers the crucial analogy was between the designer of the calculating machine and the Creator of the Universe. Had the calculating machine not been designed, it would not have behaved in a useful and impressive manner. In a similar way the Universe required a designer in order to produce anything other than disorder. Where Babbage wrote about laws, Chalmers was perhaps thinking of order and utility. It is significant, though, that he chose not to argue with Babbage about the aims and methods of natural theology. Indeed, as we have already seen, his treatment of the social system brought him very close to both Babbage and Whewell. The laws of society were invariant principles and yet also the effects of a particular, divinely-constructed collocation.

There were potential problems, however, in maintaining that the Universe was governed by invariant laws. A strong element in British theology of nature since the time of Boyle and Newton had emphasised the divine will as being more important than the divine wisdom. The clash between 'will' and 'wisdom' animated the Clarke-Leibniz controversy over the Newtonian philosophy. Leibniz found unacceptable the notion that the Creator had to intervene at intervals to prevent the solar system from falling into disorder.[74] To the voluntarists, laws of nature were expressions of the divine will; God could suspend or alter them as He wished and their apparent permanence depended on His continued superintendence. This view is

to be found, for instance, in the works of Thomas Reid:

> The physical laws of nature are the rules according to which the Deity commonly acts in his natural government of the world; and, whatever is done according to them, is not done by man, but by GOD, either immediately or by instruments under his direction. These laws of nature neither restrain the power of the author of nature, nor bring him under any obligation to do nothing beyond their sphere. He has sometimes acted contrary to them, in the case of miracles, and perhaps often acts without regard to them, in the ordinary course of his providence. Neither miraculous events, which are contrary to the physical laws of nature, nor such ordinary acts of the Divine administration as are without their sphere, are impossible, nor are they effects without a cause. GOD is the cause of them, and to him only they are to be imputed.[75]

Chalmers' teacher, Dugald Stewart, shared this image of a busy Deity, whose many operations "neither distract his attention nor exhaust his power."[76] An article in the Evangelical Edinburgh Christian Instructor (1814) similarly warned against reifying the laws of nature:

> It will not probably be disputed, that the Creator appointed what are usually called the laws of nature; that these laws have, in themselves, no inherent efficacy; that they are merely the signs from which we infer the divine agency; and that, of course, they are not independent of the Deity, but may, if he sees meet, be controuled [sic] by him, or altogether changed. It is however, a natural and a just inference, that any constitution framed by the Almighty, must have been framed for the most important purposes and that men may safely rely upon its permanence, whilst the circumstances under which it was established are not varied.[77]

There was, here, an accommodation between divine immanence and the reliability and predictability of natural phenomena. The balance between these two potentially conflicting qualities is a recurring aspect of Evangelical theology of nature. On the one hand there was a hankering after a God who directly intervened in His Creation to reward and to punish His creatures, an Old Testament divinity of pestilences and storms. Yet this notion was tempered by the admission that there were regularities in nature discoverable by

science. The balance was maintained with varying subtlety. Evangelical clergymen sometimes gave the impression of allowing it to tilt right over to the admission of direct, miraculous intervention. This tendency was especially evident during the cholera epidemics and at times of other widespread catastrophes which lacked full scientific explanation.

Cholera epidemics occurred in 1832,[78] 1848-9[79] and 1853-4.[80] Similarly in the Great Fire in Edinburgh in 1824, the flooding of Greenock in 1836, the poor harvest of the same year, the potato failure of 1845-6 and the Crimean War of 1854, clergymen detected the punishing hand of God.[81] At the time of the 1832 epidemic Evangelical commentators often reconciled the Providential character of the disease with the possibility of a scientific explanation by stressing the voluntarist notion that even the maintenance of the laws of nature implied constant divine activity.[82] However there remained the problem of the efficacy of prayer and of the Fast Days which the Government, prompted by the Church, called in response to epidemics. How could God respond to prayer and national humility without some visible suspension of the laws of nature? In a discourse on the 'Efficacy of Prayer and the Uniformity of Nature' Chalmers maintained that there need be no visible suspension since God could intervene in the chain of causes at a point remote from human observation:

> And it may be by a responsive touch at the higher, and not the lower part of the progression, that He answers our prayers. It may be not by an act of intervention among those near and visible causes, where intervention would be a miracle; it may be by an unseen, but not less effectual act of intervention, among the remote and therefore the occult causes, that He adapts Himself to the various wants and meets the various petitions of His children.[83]

In a chapter of the Natural Theology, dealing with a special providence and the efficacy of prayer, Chalmers lamented the tendency of physical science sometimes to substitute unconscious mechanism for God's continued care and superintendence of His Creation. He clearly delineated the realm of philosophy, concerned with visible phenomena, from that of religion, which dealt with a transcendental region beyond the range of observation. Apart from the very rare occasions when miracles occurred, the observed course of nature was inflexible. Influences which controlled the processes of nature belonged to the realm of religion.[84]

Chalmers thus argued that the course of nature could in a sense be simultaneously both constant and alterable. The observed constancy of nature was, in fact, an important element in his natural theology. Following Thomas Brown he maintained, against Hume, that it was an instinctive anticipation of man's nature, not, as Hume had argued, a fact learned by experience. The implantation in man's mind of this instinct was an adaptation between the mental constitution and the external world. Indeed, experience could at times qualify rather than confirm the belief:

> The constancy of nature, and man's faith in that constancy do not stand related to each other like the terms of a logical proposition, or in the way of cause and consequence. There is a most beneficent harmony between the material and the mental law - but it is altogether a contingent harmony; and the adaptation of the one to the other is perhaps the most precious evidence within our own unborrowed light, for a presiding intelligence in the formation or arrangements of the universe.[85]

Chalmers drew fom this observation a more general conclusion about the trustworthiness of "the instinctive and primary suggestions of nature."[86] Such confidence enabled him to castigate Reid and Stewart for failing to deal effectively with Hume's attack on the argument

from design. Whatever the origins of the belief, the association of a particular antecedent with a particular consequent was a "firm impregnable conviction".[87] Moreover, it required no necessary experience of the particular circumstances of production of an object in order to infer the existence of the producer. One could infer the existence of the watchmaker from examination of a watch even if one had never seen a watch being made. It was sufficient to be able to identify an assemblage of means for the achievement of an end. Similarly in the case of worlds, it was unnecessary to have any experience of world-formation to infer the existence of a world-maker. Like the watch, the world contained many instances of means brought together for the achievement of an end.

Chalmers criticised Reid and Stewart, who had separated the design argument from the normal process of inferring causes from their effects. Design, according to them, existed in the mind of a fellow creature and therefore was beyond the scope of our observation. Its existence was a matter of instinctive or intuitive belief, not something which could be inferred. Chalmers pointed out that this denied the possibility of reasoning from the phenomena of our own consciousness to the phenomena of other minds.

Yet Chalmers introduced a further complication into the discussion of the uniformity of nature with his treatment of geological change. His law/collocation (or law/disposition) distinction stressed that laws alone were insufficient to produce anything other than a chaotic melange. They could not account for the existence of an ordered universe and, were this order destroyed, laws alone could not restore it. However, Chalmers went beyond this to assert that the order had in fact been destroyed, not once but on

several occasions. In his review of Cuvier's Theory of the Earth, he described these great revolutions in global history, welcoming them for the proof they offered that the world was not eternal. In Hume's Dialogues, Philo had asserted that if he were obliged to defend any particular cosmology he esteemed "none more plausible than that which ascribes an eternal, inherent principle of order to the world, though attended with great and continual revolutions and alterations."[88] Chalmers countered this not with metaphysical argument but with alleged scientific fact. He accepted that if they had always existed, even the collocations of matter did not necessarily indicate a designer. Geology came to his aid. The earliest strata contained no animal remains at all. The earliest occupied strata contained genera no longer living. Clearly, such genera had been rendered extinct, possibly by some catastrophe; indeed according to Cuvier the fossil record indicated a series of such catastrophes and corresponding extinctions. If the world had existed from eternity the process of annihilation would by this time have been complete so that no species would survive. Thus divine miracle could not be dispensed with because creative power would have been needed to replenish the earth with inhabitants. The flora and fauna of one era were of different genera from their predecessors, and this strengthened the argument for direct divine intervention. Chalmers accepted without detailed discussion Cuvier's own dismissal of the theory of species transmutation, and held the doctrine of spontaneous generation to be "generally exploded":

> Between the one principle and the other the commencement of new genera is totally inexplicable on any of the known powers and combinations of matter, and we are carried upwards to the primary link which connects the existence of a created being with the fiat of the Creator.[89]

In the Bridgewater Treatise he repeated the argument drawn from these geological revolutions, censuring those whose speculations aimed "to explain the formation of new systems emerging from the wreck of old ones."[90] The Natural Theology contained a longer discussion of the subject and Chalmers commended the geological argument as one that "we have long regarded as the nearest to a direct and experimental manifestation of a Creative Process."[91] Chalmers dealt here not only with the eternity of the world but the possibility that maladapted forms of life might arise spontaneously. Doomed to perish, such failures robbed nature's successes of their value to natural theologians. Perhaps only successes - well-adapted forms - could exist. Chalmers had two answers to this argument. The first was that no such abortive efforts had ever been witnessed. The second was that many examples of adaptation could have been less convenient without being fatal to the species:

> We are quite sure that by going in detail over the human body, many thousands of changes could be pointed out, each entailing severe trouble and discomfort upon man, yet without hazard to the being of the individual or to the endurance of the species ... There is an infinity of examples to the same effect in the inferior creation.[92]

Chalmers disposed of species transmutation, which in 1814 he had not even troubled to disprove, in a similar way. No evidence for its occurrence could be found:

> Each actual variety through the great extent of the ascertained physiological kingdom, is perfect in its way; and there is a distinct invariable line of transmission in which, but never out of which, we behold the production of each of them.[93]

A writer in Macphail's Edinburgh Ecclesiastical Journal, an organ hostile to the Free Church, later condemned Chalmers' dependence on prevailing scientific theory in order to counter Hume:

> ... he holds that the design must be proved to be an effect before the design which it manifests can lead us to the First Cause. In short, proof must be obtained that the present order of things had a beginning, and to obtain this proof he appeals to the revelations of geology. But geology serves his purpose only in as far as it discountenances the doctrines of transmutation and spontaneous generation, so that his whole argument rests upon the truth or falsity of these doctrines ... we deplore the attempt to base the whole superstructure of Natural Theology on this the obscurest field of natural science - to substitute a faint glimmering light from the darkest recesses of nature for the bright sunshine of design reflected from all God's works.[94]

For Chalmers the constancy of nature was an essential but nevertheless temporary regime, which had been overruled in the past and would be again in the future:

> Once, in a season of miracle, did the word take the precedency of Nature, but ever since hath Nature resumed her courses, and is now proving, by her steadfastness, the authority of that, which she then proved to be authentic by her deviations. When the word was first ushered in, Nature gave way for a period, after which she moves in her wonted order, till the present system of things shall pass away, and that faith which is now upholden by Nature's constancy, shall then receive its accomplishment at Nature's dissolution.[95]

Chalmers detected even in the ordinary course of Nature signs that the world was slowly decaying and would eventually require some divine act of restoration. While retaining the distinction between natural and miraculous processes, he evidently saw them as working towards the same end:

> ... even though not anticipated by the sudden and awful convulsions of the day of God's wrath, nature contains within itself the rudiments of decay - that every hill must be levelled with the plains, and every plain be swept away by the constant operation of the rivers which run through it - and that, unless renewed by the hand of the Almighty, the earth on which we are now treading must disappear in the mighty roll of ages and of centuries.[96]

In the Astronomical Discourses he conjured up a picture of a fragile world which might at any moment be dragged towards the sun or to "the

outer regions of the planetary system" by a "blazing comet". That this would not happen was dependent upon "the protection of the Almighty".[97] Such a mixture of threat and reassurance was perfectly consistent with Chalmers' voluntaristic theology of nature, in which both the suspension and the maintenance of nature's laws involved the continued working of the Deity. Whatever happened was the Lord's doing.

Chalmers had a deep and abiding interest in natural theology, and respected the achievements of his predecessors in this field, including Paley and members of the Scottish commonsense school. There were, however, major differences between the Calvinist theology of Chalmers and the milder moral regimes which a Paley, a Thomas Brown or an Adam Smith envisaged for the universe. Indeed it could be said that Chalmers reconstructed natural theology to meet his own requirements as an Evangelical clergyman. Its intimations about the moral condition of Creation harmonised with the blight which had afflicted the world at the Fall. Even the world of non-human nature suffered to some extent under this penalty. Chalmers' published writings emphasised that the non-human Creation told us nothing certain about the moral character of its Creator. His lecture notes, however, suggest a clearer distinction between the harmonious world of animal and vegetable life and the disordered condition of the human species. His Astronomical Discourses discussed a moral gulf of a different kind, this time between fallen man and the inhabitants of other worlds. In any case, natural theology showed us its inherent limitations by demonstrating that we were under the domain of a judge as well as enjoying the benevolence of a kindly father. For Chalmers, the moral conclusions of the subject were intimately bound

up with its status. Natural theology announced the malady but could not prescribe the cure. That came from a different theology. The more one contented oneself with a regime of unqualified benevolence, the less one recognised the need for a Christian remedy to man's moral condition.

Chalmers' scepticism about the eighteenth century preoccupation with the power of reason is reflected in his writings on the Christian evidences. Man was an incompetent judge of the moral character of any Revelatiom, a view which Chalmers later qualified but did not entirely abandon. However this scepticism did not enfeeble his natural theology because this was based on observation rather than on reason. Man was not an incompetent observer of the design of the anatomical system, the workings of the social order or the phenomena of his own conscience. The methods of science could be applied to all three. Chalmers thus enlarged the scope of natural theology, reflecting his interests in the individual's moral health (as an Evangelical clergyman) and his concern with the economic discipline of the labouring classes (as a social reformer).

Chalmers was an able defender of natural theology against possible attack from all sides. He was aware that delicate balances had to be maintained. In refuting Hume by emphasising the constancy of nature, he was also alive to the risk that the unchanging course of nature could be taken as the symbol for an abstract impersonal Deity. There was a danger in confounding the atheist of playing into the hands of the deist. In neutralising the threat posed by a necessitarian view of the laws of nature, Chalmers put great stress on the collocations or dispositions of matter. He even implied in some places that the advance of natural laws signalled the retreat of

the design argument. Yet his interest in the sciences and his hopes for scientific progress ensured that such a view did not prevail. Nor was he, perhaps, entirely happy when, in the Bridgewater Treatise he appeared virtually to abandon astronomy as too barren for the natural theologian's cultivation. His earlier Astronomical Discourses had been strongly charged with the spirit, if not the detailed arguments, of natural theology and he was later impressed by William Whewell's work in this area.

Chalmers' interest in finding a role for the laws of nature in natural theology was especially evident in his social theory. He considered the laws of political economy and the Malthusian law of population to be fundamental principles laid down by the Creator, at once both natural laws and moral injunctions. There was also a degree of optimism in his social doctrines which could not be expected from reading his general remarks about the purpose and status of natural theology. He held out enormous hopes for the power of education and for the prospects of improving the conditions of the labouring classes.

Chalmers was, I suggest, strongly aware of the need to give his social teachings persuasive power, both amongst the labouring classes and amongst legislators. Legislators had to be persuaded of the folly of tampering with the economic system and thus flouting the 'natural' workings of the mechanism. He also hoped to convince national politicians of the value of clerical influence in combating pauperism and social unrest. Chalmers' economic and social gospel lent weight to his campaign of church extension, in which he sought Government money to subsidise seat rents so as to make it easier for poor worshippers to attend new churches provided by private funds.

Chalmers failed with the legislators over the issue of the poor law and his appeals to Government to support church extension were frustrated by the opposition of the Dissenters, coupled with the indifference of some elements within the Established Church (although large sums of money were raised privately for new churches). However he was more sanguine than Malthus about making individuals heed his social teachings. He was, I suggest, aware that there was no Scriptural warrant for postponing the age of marriage or for the injunction to save during periods of industrial prosperity. Rewards had to be found in the individual's moral and economic well-being.

Chalmers anticipated many of the attacks on Christian theology which could be launched by a disciple of Hume or by a deist. However, he drew as much on the detailed results of scientific inquiry as on metaphysics. Here was a major difference from the arguments of the eighteenth century and from those surrounding Leslie's election. Geology provided evidence of the non-eternity of the world and for repeated creative interventions in the economy of nature. To a lesser extent, astronomy was also called to his aid. In the Astronomical Discourses he seemed at times to be going beyond merely neutralising any danger inherent in the plurality of worlds doctrine and incorporating the doctrine itself into his natural theology. This strategy had the disadvantage that science was vulnerable to new discoveries. The plurality of worlds was less hazardous than geological theory because most commentators agreed that it was unlikely to be demonstrated as true or false. However it was ironic that Chalmers followed such a path when he had so clearly separated the Book of Genesis from the Book of Nature with his use of the interval theory. While the claims of geology and Revelation were

prevented from competing, Chalmers' natural theology seemed to need geology to help ward off the attacks of Hume. This does not bear out Ian Clark's rather extreme suggestion that the Evangelicals actually welcomed some parts of Hume's philosophy. Rather it indicates that they continued to take very seriously his critique of natural theology and to seek better ways than those of Reid and Stewart in which to answer it.

Chapter Five

NATURAL RELIGION, NATURAL THEOLOGY AND NATURAL SCIENCE

In this chapter I examine the natural theology of Brewster, Fleming and Miller. Similarities and differences in their views are noted. Comparisons are made with the views of Chalmers. I also discuss attitudes to the reconciliation of Science and Scripture. The chapter includes an attempt to assess opinion within the Evangelical party as a whole from a survey of periodical literature, addresses and lectures. My aim here is to show the pressures which the Evangelical scientists experienced from within their own party. The account also indicates the extent of their influence on the formation of opinion.

Although Chalmers made an early and firm commitment to the value of natural theology, there was evidently no consensus in the Evangelical party about the status and utility of the design argument. My assessment of opinion is made more difficult by the fact that 'natural religion', 'natural theology' and 'the light of nature' tended to be used by commentators sometimes to mean only the design argument and sometimes the total body of divine knowledge which could be arrived at independently of Revelation. The Evangelical Presbyterian Review (1837-8) clearly recognised that the study of external nature was not the only element in natural theology:

> So far are we from believing that the study of outward nature is esential for gaining the primary position of natural theology, - the existence of God, - that we do not see the impossibility of arriving at it independently of the study of either natural or spiritual phenomena.[1]

Om the design argument itself, there was disagreement about the extent to which design was a matter of universal, immediate cognisance. Some writers maintained that man was so corrupted that he failed to perceive the handiwork of a Creator in the world around him:

> This opinion we ground not only on Scripture, which declares that they are alienated from God, and do not like to retain him in their knowledge, professing themselves to be wise, they become fools, &c. but on the undeniable fact, that there is no proof of any nation, or even of any individual, having ever, by their unassisted powers, arrived at an assured belief in the great truths of natural religion.[2]

The appeal to history provided proof that the Jews had received a Revelation from God, since natural religion would have left them worshipping a multitude of gods and idols. A writer in the Edinburgh Christian Instructor (1817) reproduced the denial made by Hume, in his Natural History of Religion, that primitive man worshipped one God, the Creator:

> ... it is an established maxim of the philosophers, that ignorant and uncultivated men are naturally, and in the common course of events, gross polytheists and idolators.

The writer used this observation not to discard the design argument altogether but to argue for the need to carry out exhaustive scientific study to obtain correct views of the Creator:

> It is only by an extensive knowledge of nature, by philosophical observation and research, and by a careful attention to causes and effects, that the unassisted reason of man can attain to the idea of the unity of God, and the true system of natural religion.[3]

Primitive minds were impressed by unusual and startling phenomena.

A more extreme, but rare, position regarded the natural world not as the embodiment of divine design but as an illustration of human wickedness, confirming the existence of a curse placed on

mankind at the Fall. This harked back to writers like Burnet in the seventeenth century.[4] The following passage, for instance, is untypical:

> The face of creation, covered with barren mountains and frightful wastes, infested with ravenous and destructive animals, and its inhabitants become the prey of painful and loathsome disease, presents a striking picture of the deformity of the human heart, since man's apostasy from God.[5]

At the opposite end of the spectrum, some writers happily acknowledged not only the existence but the power of design. Man could not ignore it unless he were being deliberately perverse:

> And we hesitate not to affirm, that he who can contemplate the works of nature, either in their larger and broader, or in their minuter proportions, and at the same time refuse to ascribe these works to the power and wisdom of A Creative Intelligence, must suppress the inference of his own understanding, and labour under prejudices of which a philosopher ought to be ashamed.[6]

Even after the publication of Chalmers' Bridgewater Treatise, however, there remained a degree of suspicion about the value of natural theology in isolation from Revelation. A review of Chalmers' work in the Edinburgh Christian Instructor suggested that the subject was a mere adjunct to revealed theology, useful in proof of God's existence and in illustration of his character only "after the existence of God has been announced to us".[7] Reviewing another work of natural theology in 1837, an article in the same journal offered a more enthusiastic estimate:

> ... natural religion, does not go far, and taken by itself is very poor indeed, yet as preliminary to revealed, it is indispensible [sic] and important.[8]

All this was insufficient to prevent a rebuke from a writer in the Edinburgh Review of 1837 in an article on 'Evangelical Preaching' (about which, as we have seen, Brewster complained to the editor):

> No attempts are ever made to excite feelings of gratitude towards the Deity, by the display of his innumerable acts of benevolence towards us and all living creatures, in the frame of our bodies and minds, and in the provision made for our sustenance and gratification in the constitution of the external world. No sentiments of reverence are ever sought to be excited, by pointing the view to the wisdom and power so strikingly exhibited in everything we behold around us.[9]

I have sketched in a background of mixed but by no means unsympathetic opinion about natural theology amongst the Evangelical clergy and educated laity. Let us now consider its significance for Brewster, Fleming and Miller. The development of Brewster's views is of particular interest in that he was one of the combatants in the extensive pamphlet warfare at the time of Leslie's election. Under the pseudonym 'Calm Observer', Brewster feigned a defence of the Moderates but it was easy to apprehend the bitterness of the underlying message. Moderate manners and metaphysics emerged in tatters. Striking a passing blow at their alleged neglect of parish visiting, Brewster proceeded to ridicule the Moderates' hastily concocted objections to Leslie. Like Andrew Thomson and William Brown, he was at pains to emphasise that there were many different ways of proving the existence of God:

> The arguments for the existence of Deity had long been frittered down into a variety of parts, by the injudicious Clarke, Butler, and other writers on natural religion; but the moderate clergy in our church, have dismissed, simpliciter, the a priori argument, in as far as they have proved that Mr Leslie, by attacking the doctrine of necessary connexion, has denied all arguments whatever for the being of a God - Hence we may deduce this beautiful corollary, that a man born blind, and having no source of information respecting the evidence of design in the universe, can never infer, from his own experience, the existence of a first cause.[10]

Design was not dismissed but nor was it to be allowed the privileged status which the Moderates sought to confer on it. As I have already

suggested, the metaphysical opinions expressed during the Leslie debates may have been developed in a somewhat ad hoc fashion to suit the political purposes of the contending parties. According to Mrs Gordon, Brewster never afterwards referred to his satirical composition, written when he was only 24.[11] Further insight into his natural theology can be gained from his popular scientific writings, especially for the periodical press.

Despite his own work in optics, Brewster felt that inorganic sciences such as astronomy provided less forceful statements about the divine character. Astronomy was a 'high' science, practised by an elite, leaving the generality of mankind to take on trust its discoveries. Even physical sciences more accessible to the majority were of limited value to natural theology. Brewster agreed with Chalmers that it was living phenomena which excited the deepest sentiments of reverence:

> It is only in the organic structures of our own globe that the mind experiences in its full force the strong and united impulse of admiration, gratitude and love.[12]

Of the three Bridgewater Treatises which Brewster reviewed, he therefore found the subject matter of Roget's (animal and vegetable physiology) and of Buckland's (geology and mineralogy) more congenial than that of Whewell's (astronomy and general physics). Even between his reactions to Roget and Buckland, a further distinction was evident, since Brewster observed a certain unwillingness to acknowledge "miracles of power" evident in the structures of living creatures. Palaeontology was preferred to zoology because there was

> ... something unclean about animal bodies, and their functions, and their products, which deters all but professional men from their study, and therefore robs them of their inherent claims as incentives to piety and as proofs of design.[13]

Brewster had far greater reservations about Whewell's Treatise. He had already crossed swords with the author in the decline of science debate. A further provocation had been the Cambridge group's support for Forbes in the 1833 election for the Edinburgh chair of natural philosophy. The harshness of his critique undoubtedly stemmed partly from the grinding of personal rather than philosophical axes. However it is difficult entirely to separate the two areas, since Brewster's differences with Cambridge already involved not only clashes of personality but disagreement about the aims and methods of science. I want to assess whether Brewster's attack on Whewell's natural theology was a fundamental objection to Whewell's approach, whether it was made simply because of his existing dislike of the Cambridge circle or whether it was provoked by Brewster's reaction to particular statements in the work, especially in connection with the undulatory theory of light.

The second factor certainly played a part, whilst the third merges with the first. Brewster was enraged that Whewell had deduced "proofs of divine wisdom and skilful adaptation" from the theory and its associated ether.[14] The Scottish physicist never fully accepted the wave theory but as Cantor[15] and Morse[16] point out, he did not mind it being used to make and test predictions, provided that the experimenter continued to treat it as a hypothesis. It was unforgivable, though, to incorporate it into natural theology when its status was so uncertain. If the theory were subsequently discarded, natural theology would be damaged; the loss of the wave theory and of the luminiferous ether would appear to detract from the design argument to which they had previously contributed. Morse has suggested that such considerations were in fact regulative of

Brewster's natural philosophy. He refused to admit the undulatory theory into the sanctum of established science because there was no independent evidence of the existence of the luminiferous ether. It was a purely hypothetical entity. To allow it entrance would be to profane the temple.

Brewster's reaction to Whewell's work was in marked contrast to the praise bestowed by Chalmers. Indeed, the programme which Brewster called on natural theologians to carry out seemed a very limited affair. Even to trace the adaptation between different elements in Creation was a hazardous enterprise. Thus Whewell's explorations of the correspondence between the length of the year and the life cycle of fruit and vegetables suggested a limitation of the divine power in not providing a means of coping with a different length of year:

> ... the very want of this limitation, or the existence of an elastic energy in organic bodies by which they could accommodate themselves to a residence on every planet in the system, might be held to be a proof both of divine wisdom and power.[17]

As John Brooke has pointed out, where Whewell stressed the divine precision, Brewster seemed to want natural theologians to emphasise the divine resourcefulness.[18] He also argued strongly for the empirical and participatory character of natural theology. His interpretation of the Bridgewater bequest for works illustrating the "Power, Wisdom and Goodness of God as manifested in the Creation" laid heavy stress on the word "manifested". Natural theology, according to Brewster

> ... has, therefore, nothing to do with speculations and theories, however ingenious or well founded. It deals primarily with the manifestations or unimpeachable proofs of design in created things, and only in a secondary manner with the deductions of science ... We may admire the power,

> and wisdom, and goodness of the work, without knowing how it was executed, and without any acquaintance with the laws of nature which are concerned in its agency and observation.[19]

Natural theology rested on natural history, whose facts were available to all. Yet there was a tendency in parts of his review of Roget's work to contradict this ruggedly democratic empiricism. Perhaps detailed investigation was, after all, needed before design became apparent, certainly with its full force:

> While the vulgar gaze in mysterious wonder at the results of creative power, the student of nature perceives the unity of design and of purpose which pervades the whole; and he is permitted to trace the steps and pursue the laws by which the Omniscient Spirit has accomplished his Work.[20]

Of course, without such a view of natural theology, no theological legitimacy was conferred on scientific inquiry. All were natural theologians, whether they had scientific training or not. Indeed, Brewster in the same article admitted the "melancholy fact" that "those who have done most in the field of natural science, have learned the least of the sacred lesson which it conveys."[21] He hastily qualified this gloomy assertion by noting that there were many exceptions. However, this does suggest a tension between wishing to confer theological respectability on elite science and the desire to emphasise the possibility of a universally available natural theology.

This tension perhaps sprang from the varied nature of Brewster's interests and the problems encountered in his own career. He was both a campaigner for popular scientific education and an advocate of increased state support for scientists. On the one hand, Brewster was concerned with broadening the base of scientific education but on the other he wanted to improve training for a university elite. In

1821, he founded under the auspices of the Edinburgh Society of Arts a direct competitor to the Edinburgh School of Arts, started by Leonard Horner in order to educate mechanics in the practical subjects of chemistry and mechanical philosophy. Brewster was alive to the value of natural theology as a form of social control. The manifesto of the Society referred to the importance of withdrawing the working classes "from those political and metaphysical speculations, which too often interrupt their habits of industry and subordination."[22] However he also sought means of training a new breed of research scientist. In his evidence to the first Royal Commission on the Scottish Universities, appointed in 1826, he argued for a separation between the experimental and the mathematical parts of the natural philosophy course at Edinburgh, the mathematical elements being removed to an advanced class.[23] In this way he aimed to revitalise science teaching in the university, emphasising in the basic class the craft of the experimenter and the relationship between science and technology. The suggestion was repeated by Brewster when he was a candidate for the natural philosophy chair in 1833.[24] He also attacked the heavy reliance of professors on class fees to provide their income. This encouraged showmanship and a pandering to popular taste in preference to serious teaching. Brewster was a poor public speaker who had failed to secure an academic appointment by the time he wrote his 'Decline of Science' article in 1829. He regarded some of his rivals as little better than performers in some scientific travelling circus:

> In this age of extended and diluted knowledge, popular science has become the staple of an extensive trade, in which charlatans are the principal dealers. No sooner is a professor installed behind the counter of his lecture-room,

> than it becomes his single object to enrich himself with the fees of his ready money customers. His handbills announce the qualities of his wares; - the cups and balls and the fire-works of science are summoned into requisition and by the legerdemain and alchemy of his art he transmutes his baser metals into gold.[25]

Later, as a supporter of the Association for Extension of Scottish Universities, he sought the endowment of additional chairs and the development of what was effectively postgraduate training in order to produce specialists similar to those emerging from continental universities.[26]

Brewster thus operated in two distinct modes: as research worker in the physical sciences and as a scientific populariser and educator. His hierarchical view of scientific activity, his distinction between advanced and popular science, is, I suggest, a helpful means of considering his attitude to scientific methodology. He was not averse to theorising, provided that it was done by those who were properly qualified and provided that hypotheses were not then distributed freely to the masses as if they were items of certified knowledge. In a letter to J.D. Forbes in 1830 he urged his protege:

> Forget entirely all that you have heard of Lord Bacon's Philosophy. Give full reins to your imagination. Form hypotheses without number.[27]

A positive disdain for the process of mere fact-collecting is shown in a letter to Whewell. Written in 1825 on Whewell's appointment to the Chair of Mineralogy at Cambridge University, it preceded their violent disagreements:

> Mineralogy will acquire a new form and character, and will soon make its escape from the Butterfly catchers & the Cabinet fillers of the present day.[28]

Similarly, in his review of Buckland's Treatise, Brewster censured

the Geological Society of London for its timidity in the face of religious prejudice against the science. Its principle of collecting "only the material of future generalisations" was "the sacrifice of high principle to the fanaticism of the hour".[29] Such remarks confirm that Brewster was no simple Baconian. Indeed, Davie argues that Brewster's science was typically Scottish in having a strong anti-Baconian, deductive component.[30] Certainly, his prescriptions for natural theology were not the same as those for natural philosophy.

When it suited him, Brewster was prepared to use the standards of elite science to categorise works of natural theology, In 1839, grateful to Lord Brougham for his state pension and for his appointment at St. Andrews, he wrote a review of the statesman's Natural Theology for the Monthly Chronicle. "The aim of Lord Brougham", declared Brewster, "has been to raise the many to the level of science, not to lower science to the level of many." This was in marked contrast to "the tawdry magniloquence of Dr. Arnott, and the loose rhapsodies of Dr. Mantell."[31] Brewster thus maintained that Brougham operated on a higher level than that of other contemporary natural theologians.

As a populariser and educator, Brewster had a vivid idea of how natural theology could operate on the mind of the student. Interestingly, he emphasised the dynamic aspects of nature as well as the static ones. It was not merely design but processes of change which induced sentiments of piety. Like Chalmers, he found geology an ideal source of such illustrations. The introduction of new forms of life at the start of each geological cycle offered us hope that our own "mouldered frame" would be "purified and recombined."[32]

Destruction too, contained moral lessons and Brewster clearly relished conjuring up descriptions of the primaeval world in a state of upheaval and chaos:

> The commencement of organic life in plants and animals of the first period, and its higher and progressive development in different orders of beings, leads us back to that beginning which was so long veiled from human reason; while the successive destruction of successive creations carries us forward to the terminus of our own period - to that "day of the Lord, when the heavens shall pass away with a great noise, and the elements shall melt with fervent heat, and the earth also, and the works which are therein, shall be burned up."[33]

The study of plants and animals provided other instances of transformation. Examples of growth and metamorphosis represented a "rehearsal of that glorious renovation which awaits our own disintegrated frame."[34] The moral value of scientific instruction, a frequent subsidiary theme in Brewster's writings, assumed added significance with advancing years. His addresses to the Edinburgh Philosophical Institution and to students of Edinburgh University were rich in the rhetoric of natural theology, combined with a strong emphasis on the practical benefits of science and technology. Indeed, Brewster was able to connect the utilitarian view with loftier considerations by stressing the labour-saving benefits of machinery, raising man to a higher sphere in which "the ingenuity of his mind is combined with the exercise of his body." By technology, the workman could be removed from "a professional level with the brutes that perish."[35]

As far as the forcefulness of the design argument was concerned, Brewster, like Chalmers, was aware of the devastation inflicted by Hume. In an earlier review of Brougham's Natural Theology, Brewster criticised Chalmers' reply to Hume. As seen in chapter four,

Chalmers endeavoured to show that it was unnecessary to have experience of the circumstances of producing a particular object in order to be able to infer design. We could infer the existence of a watchmaker even without ever having seen a watch being made. The particular characteristics of the watch, such as its weight, size and colour, were quite irrelevant to the manifestation of design. Brougham had adopted a similar, but less complicated strategy, which Brewster preferred:

> The process of the theologian lays the argument open, by its pretension to minuteness, to fresh devices of the enemy. That of the statesman repels them by its boldness and its breadth.[36]

In other respects, Brewster aligned himself with Chalmers in the article, praising his distinction between the laws and the dispositions of matter and regretting that Brougham had not included a section on "the adaptation of the external world, and of the physical and mental powers, to the position of man as a member of the social body."[37] Brewster also repeated Chalmers' claim that the uniformity of nature had been interrupted, drawing evidence from the revolutions of geology.[38] Brewster's aim, however, was not to prove the non-eternity of the world but to refute Hume's objection to miracles. The argument was brought forward in order to supplement Brougham's refutation, which stressed that, like belief in the occurrence of the Biblical miracles, our belief in the uniformity of nature itself rested on the evidence of testimony. Brewster was thus taking a step beyond Chalmers by using the discoveries of science to give greater plausibility to the announcements of Revelation.

Fleming, like Brewster, Chalmers and members of the commonsense school, admitted the force of the argument for a Deity deriving from

the displays of power in the material world:

> So simple is this effort of the mind, and so easily excited by the smallest degree of reflection, that the belief in a Superior Being may be considered as universal among mankind. Nations may be found who have scarcely devised signs to express their ideas on this subject, and over whom, their notions of Deity may exercise little control; but we can scarcely believe it possible for man to exist in any stage of society, without being furnished by the natural operations of his mind, with the first principles of religion.[39]

Fleming qualified his estimate of natural religion with an observation worthy of Chalmers or Calvin himself, concerning the moral deficiency of human nature. Although we possessed a conscience or moral sense its strength was in general too feeble to regulate human conduct. Indeed the divine origin of Christianity could almost be proved "from the circumstances of its containing an account of our own imperfections whose existence human partiality would never have discovered, nor human pride acknowledged."[40] Yet natural theology was important, not least in training clergymen. In 1832, Fleming wrote to Chalmers declaring his view that " a great deal of modern infidelity" sprang from "the absence of instruction in Natural Religion from our Publick Seminaries", and commending Chalmers' scheme to reform theological education, which involved giving natural religion a more prominent place.[41] At St. Andrews, Chalmers had proposed to the Commissioners appointed to visit the Scottish Universities that there should be at least four professors in the theological faculty instead of the current three (divinity, Hebrew and Oriental languages and Church history).[42] The divinity professor had to cover natural theology, the Christian evidences and systematic and pastoral theology in a four year course, though attendance was

required in only three sessions. As a result, students did not necessarily enter the course at the beginning and could miss one subject out altogether. The same disadvantage existed when Chalmers took the theology chair at Edinburgh.

Lecture notes taken in Fleming's class at Aberdeen suggest that he was willing to justify the study of natural philosophy partly on the grounds of its aid to the elucidation of final causes. To the question "Are we qualified for the examination of final causes?" the notes contain the answer:

> It is inherent in our nature, and it is the duty of the Natural Philosopher, to endeavour to trace not only the secondary causes of phenomena, but also the final causes or purposes in view by the Deity.
> ... proceeding in our investigations from remote to more remote causes, we at length invariably arrive at the Great First Cause; And thus are enabled to reason in regard to the purposes of an All Wise creator.[43]

When Fleming turned to the business of scientific inquiry, he was very cautious in making any generalisation which involved an explanation in terms of a final cause. Like Brewster in his review of Whewell, Fleming was wary about claiming to discover principles of adaptation which might appear to limit divine resourcefulness or adaptations which might actually involve inconvenience and pain to some species while they benefited others. The remedy lay in a strict and unswerving empiricism. In his article, 'Hybernation', for the Edinburgh Encyclopaedia, he condemned those who considered the torpidity of birds in winter to be absent because, unlike quadrupeds, they could migrate to warmer places:

> This mode of reasoning, however, is faulty, since we employ our pretended knowledge of final causes, to ascertain the limits of the operations of nature, and cannot be tolerated in a science depending entirely on fact and observations.[44]

In the Philosophy of Zoology, he stressed the one-sidedness of

looking only at the ways in which certain animals protected themselves against predators and ignoring the interests of the predators themselves. What benefited the victim deprived the hunter and if, for instance, the white covering of the alpine hare and the ptarmigan effectively hid them from their enemies, "the eagle, the cat, and the fox ... would be in danger of starvation and death."[45] The purpose of the white coat was in fact to keep the animal or bird warm in the winter. In this case then, a benevolent adaptation could be found, although Fleming admitted that there was some suffering and carnage in nature whose purpose was not apparent:

> It would be impious in us to inquire why the waster has been created to destroy. It is enough if we know that rapacious animals occupy a station in the scale of being.

His image of nature recalled more strongly the competitiveness and harshness of Malthusian political economy than the benevolence and harmony of Paley's "happy world":

> There is a wasteful war everywhere raging in the animal kingdom. Tribe is divided against tribe and species against species, and neutrality is nowhere respected. Those which are preyed upon have certain means which they employ to avoid the foe; but the rapacious are likewise qualified for the pursuit. The exercise of the feelings of benevolence may induce us to confine our attention to the former, and adore that goodness which gives shelter to the defenceless, and protection to the weak, while we may be disposed to turn, precipitately, from viewing the latter, lest we discover marks of cruelty, where we wished to contemplate nothing but kindness. These feelings are usually the companions of circumscribed and partial observation, and fall far short of the object at which they aim.[46]

Like Brewster, Fleming was no crude Baconian. He did not condemn all theorising per se. Rather, he maintained that it was a difficult and error-prone activity, for which few were properly qualified. It might be tempting, on the evidence of some of his statements, to categorise Fleming as an adovcate of the

participatory, anti-theoretical approach to nature. In fact, he operated far more consistently than Brewster in the 'elite' mode. The processes of observing and gathering data were themselves liable to be upset by the seductive appeal of premature generalisation. Few had the ability and training to persist with the one and resist the other. For the masses, natural theology was therefore a hazardous pursuit. "Explanations or conclusions founded on assumed facts are called Hypotheses, on confirmed facts, Theories", he told his Aberdeen students:

> In forming a Theory, the judgement is chiefly exercised - the Hypothetical method may be styled the royal road to philosophy, but seldom does it lead to the end proposed, as it is guided only by the imagination. The fabrication of Hypotheses is very easy, as we can make them to suit our purpose, neither are we obliged to establish our premises - and a tendency to fabulous and visionary Hypotheses is one of the Idols of the Human mind.[47]

Fleming was very cautious in his own theorising and an outspoken critic of the theorising of others. A number of leading men of science felt the stings of his methodological lash. In chapter seven, I discuss his attitude to geological theory, his attacks on the Huttonian system and his gradual alienation from the Wernerian school. In zoology and botany, too, he was an arch enemy of speculation and quite undeterred by the scientific eminence of those he attacked. One of his targets was the French comparative anatomist, Georges Cuvier. In reasoning about the form and habits of creatures from the fragmentary evidence of their fossil remains, Cuvier maintained that there were certain invariable co-occurrences of different organs in animals. This enabled him to infer, for instance, that a hoofed animal would be a herbivore. Such "specious reasoning" was rejected by Fleming. Not only was it empirically

false, since (for example) not all herbivorous animals were hoofed, some like the hare being digitated. It also imposed a limitation on the resourcefulness of the Creator:

> Indeed, the number of varieties included under one species, the number of species belonging to a genus, and the number of genera in an order, intimate the variableness of the conditions of co-existence, and the absence of those supposed laws of relation, the belief in the mathematical necessity of which, has contributed to augment the clumsy fabric of modern Materialism.[48]

The principle invoked by Fleming was in the spirit of Chalmers' remarks about the tendency of general laws to reduce the evidence of design and to increase the possibility of chance or necessity. However, Fleming's application of the principle was far more rigorous than Chalmers', who had praised Cuvier's zoology.[49] Brewster, too, reported uncritically Cuvier's "law of co-relation or co-existence" in an article of 1844.[50] Indeed it was most unusual to see Cuvier's name being linked with materialism.

Fleming was also a sharp critic of what he considered to be false systems of classification. In a review (1829) of Bicheno's 'Systems and Methods in Natural History', he distinguished methods calculated to highlight the differences between organisms from those designed to illustrate their affinities. The dichotomous method, in which each sub-division was successively divided into two, depending on the presence or absence of a particular characteristic, was inadequate for exhibiting similarities between species. Cuvier again, together with Linnaeus and Jussieu, were censured for imagining "that animals and vegetables might be exhibited according to their affinities, by a single natural method".[51] Fleming went on to deny the existence of a metaphysical scheme underlying the realm of living nature, a 'law of continuity'. He traced the origins of

the notion to mechanics, where it was observed that "a body, in passing from one portion of time to another, or from one portion of space to another, passes through all the intermediate portions of time and space." However, even physical analogies opposed it, since astronomy displayed "great leaps" in giving moons to some planets and not others and in providing Saturn with a ring.[52] Similarly, chemistry's theory of definite proportions suggested discontinuity rather than the reverse.

Fleming was aware of the use which could be made of such a law by advocates of progressive development, the transformation of one species into another. I discuss his reactions to the development theory in more detail in chapter seven. However, he heaped scorn on the law of continuity whether it referred to the existing Creation or to a temporalised version taking account of the fossil record. The naturalist William Macleay's system of "circular affinities", and Lamarck's theory of development were both cut to pieces by Fleming's critical knife. Macleay envisaged the animal and vegetable kingdoms as two circles, meeting at the points occupied by the lowest members of each.[53] Tracing affinities between the classes in the animal kingdom led one from Acrita to Radiata to Annulosa to Vertebrata to Mollusca and so back to Acrita. Each class consisted of five orders, the affinities of which also formed circles. Similarly, each order consisted of five tribes, and so on downwards.

Fleming marshalled empirical evidence against the law of continuity but his fundamental objection was, I suggest, based on metaphysical notions about the unlimited capacities of the Creator to vary his creations. Fleming did not want to find any simple underlying plan. He therefore could not tolerate the position to

which a defender could retreat of suggesting that the gaps could be filled with undiscovered or extinct creatures. The final blow to the theory was the enormous gulf which separated man from the rest of the animal kingdom:

> They [those who believed species could be linked together in a continuous thread] have attempted to train Nature to walk over a course, which they have marked out, with an equal pace. But, greatly to their annoyance, she occasionally makes a halt - as when she refused retractile claws to the hunting tiger; indulges in folicsome leaps, as in passing from the vertebral to the invertebral animals; - and completes the confusion of those who wish to train her, by bolting off the course, to convey Man to his rational throne.[54]

Even the strongest advocates of the scheme had not dared to hope for "the discovery of a semirational species to fill up the greatest gap which exists." This sense of nature breaking out of man-made restrictions ran through all Fleming's writings. In an article of 1853 discussing classification, he stressed that in the natural method we attempted

> ... to exhibit the plans and procedure of the Creator - the relations which he has established, and the harmony, which, by various and complicated adaptations, appears everywhere to prevail.

To pervert such a pursuit by imposing man-made categories was tantamount to impiety. Fleming again emphasised the enormous variations which occurred in the development of individual organs, even in closely-related species, so that "having selected our system of organs, some of the other systems will appear in rebellion."[55] A corollary was that the habits and distribution of a species could not be inferred from the habits and distribution of another species of the same genus. This restriction on analogical reasoning was, as we shall see, deployed in a number of geological controversies.

Fleming's suspicion of hypotheses was noticed by contemporaries.

His friend, Sir Charles Lyell, actually grew alarmed by the number of controversies in which Fleming became embroiled, warning him that he was being labelled "the Zoological Ishmael".[56] After his death, Dr William Carruthers declared that Fleming "sought to reproduce the language & teaching of nature - the more simply and the more faithfully the better" and noted his contempt for "naturalists who went to the study of the science of observation in the same way as they would have entered upon the study of philosophy".[57] The Eclectic Review suggested that his "uncompromising opposition to hollow pretence and showy hypotheses" had made enemies and hindered his advancement.[58]

Miller was involved in fewer scientific controversies than either Brewster or Fleming. However, as with Brewster and Fleming, there was the recurring theme in his writings of nature's extraordinary diversity, a sense of nature breaking through boundaries and limitations imposed by man. Miller was able to reconcile this belief in nature's boundless resourcefulness with an ability to detect a plan running through Creation:

> It is a law of nature that the chain of being, from the lowest to the highest form of life, should be, in some degree, a continuous chain; that the various classes of existence should shade into one another, so that it often proves a matter of no little difficulty to point out the exact line of demarcation where one class or family ends and another class or family begins.[59]

Miller was adamant that such gradations lent no support to the theory of species transmutation since they could only be appreciated by bringing together the fauna and flora of distinct geological periods, often remote from one another in time. However he praised the "marvellous analogies which pervade the scheme of Providence, and unite, as it were, its lower with its higher parts."[60] Fleming may

have found such observations dangerous but would have approved more wholeheartedly of the remarks with which Miller concluded a chapter on the ichthyolite groups of the Lower Old Red Sandstone:

> I have referred to the consistency of style which obtained among these ancient fishes, - the unity of character which marked every scale, plate, and fin of every various family, and which distinguished it from the rest; and who can doubt that the same shades of variety existed in their habits and their instincts? We speak of the infinity of Deity, - of His inexhaustible variety of mind; but we speak of it until the idea becomes a piece of mere commonplace in our mouths. It is well to be brought to feel, if not to conceive of it, - to be made to know that we ourselves are barren-minded, and that in Him "all fullness dwelleth.[61]

Unity and variety could thus co-exist.

In his natural theology, Miller carefully avoided exalting order and plan above all else. In his later work, this concern is particularly evident. Miller protested against a natural theology based on "the mere order of the universe as itself an end or final cause." He associated this doctrine with deists of the early eighteenth century such as Bolingbroke and Soame Jenyns, and in a modified form, with Alexander Pope's Essay on Man. Theirs was a cold, abstract Universe, in which the human species was rendered a mere link in a chain. Insignificant, yet at the same time "as perfect as he ought to be", man was left to work out his own destiny, unremarked by the Deity whence the order originated.[62] This was not the kind of Creator whom Miller worshipped. He condemned contemporary developments in morphology, notably in the work of the Naturphilosoph, Lorenz Oken, which revived such notions as analogy and continuity between man and the lower animals, and held man to be "God manifest in the flesh."[63] Although Oken's theology was thoroughly objectionable, Miller was attracted to elements of his transcendental biology, which discerned a unity of type running

through the whole of the vertebrate creation. The doctrine appeared in much more palatable form in the work of the anatomist, Richard Owen, and the palaeontologist, Louis Agassiz. Miller's sympathies distinguished him from other members of our group, and especially from Fleming.

Like Brewster and Chalmers, Miller had high hopes of the tranquillising and civilising effects of popular scientific instruction, particularly for the labouring classes. In the Christian and Civic Economy of Large Towns, Chalmers had observed the affinity which existed between "a taste for science and a taste for sacredness", adding a warm recommendation for the establishment of mechanics' institutes.[64] The opening pages of Miller's Old Red Sandstone advised working men to avoid Chartist meetings and, instead of pursuing political objectives, to seek power of a different kind through the acquisition of useful knowledge.[65] Self-educated himself, Miller felt that the simpler propositions of science were those which best served to illustrate the character of the Creator:

> In all those works on Natural Theology that treat, like the work of Paley, on the argument of design, the assumption of a certain unity of the intellectual nature of the Creator and creature is made, tacitly at least, the basis of all the reasonings; and it is in the cases of which the design is most simple that the argument is most generally understood.[66]

Miller also followed Chalmers in his use of geological discoveries to counter the possibility that the world was eternal, a theory he thought had been rendered "inconceivable" by metaphysicians, but not "impossible".[67] Appearing briefly in First Impressions of England, where Miller dealt specifically with an infinite series of men, the geological refutation re-appeared in a lecture to the Royal Physical Society in 1852[68] and in Testimony of

the Rocks,[69] applied to living creatures generally. All living races were shown by palaeontology to have had a definite beginning, during the Tertiary period.

In the lecture and in Testimony, Miller ventured further into metaphysics, perhaps seeking to justify his prediction in First Impressions that the time would come when "writers on the evidences of the two Theologies, Natural and Revealed, will be content to borrow largely from the facts of the geologist."[70] Not content with Chalmers' defence of the design argument, Miller appeared to accept Hume's contention that, treating the world as a singular effect, it was impossible to infer the existence of a designing cause. Miller claimed that Hume's premises were overturned by geology. The world was not a singular effect but the most recent of a whole series of creations, each increasing in power on its predecessor. This enabled us to infer the existence of a Creator and gave us grounds to believe in a higher and more perfect creation to come. Miller thus wrested the design argument from Hume's destructive grasp. However, he pushed it even further than had Chalmers into the clutches of ascertained geology.

Brewster, Fleming and Miller were in broad agreement about the reconciliation of Scripture and geology, though changes did take place through time. In 1828, Brewster was reluctant to publish an article in the Edinburgh Journal of Science by the geologist Sir Walter Calverley Trevelyan, which argued for a partial rather than a universal Mosaic Deluge. He explained to Trevelyan that a non-universal interpretation "would have a direct tendency to unsettle the religious convictions of many Christians". Brewster urged Trevelyan to read a book on the Deluge by the Scriptural geologist,

Granville Penn, for its demonstration "in ye clearest manner that Geological phenomena are in perfect accordance with the literal statements in Genesis".[71]

Less than nine years later, in his review of Buckland's Bridgewater Treatise, Brewster's tone had changed radically. He stood forward as the champion of geology against religous prejudice, lamenting the time when geologists had been forced to work "in chains forged by presumptuous theology". Buckland's decision to abandon the diluvial theory was welcomed as the removal of "the incubus which had pressed so fatally upon his science".[72] Brewster deprived Moses' "tranquil deluge" of all geological efficacy and censured Moderate divines of the past who had seized upon the apparent conflict between science and Scripture merely for political purposes.[73] This may have been a reference to the Leslie affair, when some of Leslie's remarks about the depths of primaeval time had occasioned Moderate censure:

> The truths of religion and of science can never be at variance. A geological truth must command our assent as powerfully as that of the existence of our own minds, or of the Deity himself; and any revelation which stands opposed to such truths must be false. The geologist has therefore nothing to do with revealed religion in his scientific enquiries. It is the office of the divine to interpret the sacred canon; and if he does it with the discrimination and learning it demands, he will never find it at variance with the deductions of science. If scripture, on the contrary, is studied by instalments, and viewed from insulated points, and interpreted literally, in its detached passages, we shall find it at variance with itself, and shall reproduce all the heresies which have disgraced the history of the Christian Church.[74]

There was no anxiety here about disturbing the faith of impressionable minds, no timidity about prescribing the respective roles of the geologist and the cleric. Brewster's strident rhetoric clearly carried the implication that the clergyman must be prepared to give way occasionally to the scientist. However, the passage also

exuded confidence that geology could not possibly overturn any important parts of the sacred text and that the effects of scientific discovery on Scriptural interpretation could only be beneficial.

Brewster later retreated from such bold formulations. Even in his review of Buckland's Bridgewater Treatise, he had regretted the use of "extravagant numbers" in discussions of geological time, preferring words like "indefinite".[75] As we shall see, the publication of Vestiges and his dispute with Whewell about inhabited worlds led him to be even more cautious about the antiquity of the Earth. In 1864 Brewster (along with Sedgwick, James Joule and 714 others) signed a declaration produced by a group of London chemists in the wake of the controversy in the Church of England over the Broad Church party's Essays and Reviews. Nearly half the clergymen in the Churches of England and Ireland had responded to the liberal school of theology with the 'Oxford Declaration' on the authenticity and authority of the entire Bible. It provided the model for the scientists' declaration, which expressed "sincere regret, that researches into scientific truth are perverted by some in our own times into occasion for casting doubt upon the Truth and Authenticity of the Holy Scriptures." The document noted that physical science was incomplete and man's reason finite but looked forward to a time when "the two records will be seen to agree in every particular." Until then, the signatories regretted that "Natural Science should be looked upon with suspicion by many who do not make a study of it, merely on account of the unadvised manner in which some are placing it in opposition to Holy Writ."[76] With such anodyne wording, the authors evidently tried to offer hope of lasting peace between those who put science before Scripture and those who put Scripture before

science. However, it was a sign of changed times that the existence of two opposing parties now had to be recognised. Five years after the publication of the Origin of Species and four years after the famous debate at the British Association between T.H. Huxley and William Wilberforce, the Declaration could only offer a prospect of eventual accord between the Bible and science. Though the Declaration might seem even-handed enough towards the rival claims, many leading men of science refused to sign, including Owen, Faraday, Whewell, Airy, Lyell, Murchison and Tyndall. The non-signatories represented a broad range of religious opinion and the Declaration clearly had acquired the reputation of putting concern for Scripture before a dedication to free inquiry. By signing, Brewster made common cause with many whose opinions on the relationship between science and Scripture he had once opposed.

Near the end of his life, Brewster perhaps lost interest altogether in the problem. This coincided with the deepening of his own Evangelical faith. In 1867, he declined, on the grounds of his limited geological knowledge, to give an opinion of a theory of creation sent to him by a would-be harmoniser of Genesis and geology. Brewster suggested that the theory might be well received by the Victoria Institute (a society for the defence of Scripture against the opposition of 'false' science), adding:

> When Geologists make any discovery that Science must accept, and which stands in clear opposition to Scripture it will be time for Christians to give it their best consideration.

This view was perhaps little different from Brewster's earlier denunciation of religious prejudice, although expressed with little of its former vigour. Indeed, he remarked rather wearily:

> I have long ago ceased to trouble myself with such difficulties. The wisdom of the world is not a match for the Christian Faith.[77]

Fleming was even more strident than the unregenerate Brewster in his insistence that nature and Scripture must be allowed their separate domains. Again, there was a very clear implication that the interpretation of Scripture must sometimes yield to a scientific discovery. However, in his controversy with William Buckland over the diluvial theory, he was able to stand forth both as the champion of free scientific inquiry and as the defender of the sacred text. Buckland's theory was not only at odds with science in exaggerating the erosive power of a single flood. He was also perverting the Scriptural account, first in suggesting that the Flood had been violent, and secondly, in using it to account for the extinction of species. Cuvier, with a different diluvial theory from Buckland, was also taken to task. He held that a revolution had taken place before the creation of man, in which the sea and the continents had exchanged places. The Flood had returned the sea to its former bed, had left few geological deposits and had not caused the extinction of any species. This created other difficulties with the Mosaic account since Genesis declared that the waters returned from the surface of the earth afterwards. Cuvier's account also suggested that the deluge was of a kind which allowed different races of men to escape by different routes, whereas from Moses we knew that "all that escaped of the human race, were eight individuals of the family of Noah."[78]

Over twenty years later, Fleming, looking back to this time, described Cuvier's Theory of the Earth as "decidedly anti-scriptural

in many of its bearings", a work in which "science, falsely so called, and revelation, appeared in antagonism."[79] Once again, Fleming differed from Chalmers in the severity of his reaction to Cuvier. The paper which brought out the Scriptural arguments against Buckland and Cuvier was Fleming's final salvo in a long campaign in which the scientific had loomed much larger than the exegètic arguments. There were, in fact, several aspects of Fleming's opposition to Buckland and Cuvier, including his dislike of all 'revolutionary' interpretations of earth history. A second factor which we have already noted was his concern for the integrity of Scripture. A third aspect was undoubtedly his desire to keep Scripture and geology apart for the good of geology. As an infant science it deserved to be given a chance to develop, whereas the moral authority of Revelation was already well-established. Scripture neither needed nor could expect any support from geology:

> It would be favourable to the progress of geology, were its cultivators more disposed to examine the structure of the earth, and the laws which regulate the physical distribution of its inhabitants, and less anxious to give currency to their conjectures, by endeavouring to identify them with deservedly popular truths. It would be equally favourable to the interests of Revelation, were the believer to reject such faithless auxiliaries, and instead of exhibiting a morbid earnestness to derive support to his creed from sciences but remotely connected with his views, calmly to consider, that Geology never can, from its very nature, add the weight of a feather to the moral standard which he has embraced, or the anticipation of eternity in which he indulges, even should he fancy that it has succeeded in disclosing the dens of antediluvian hyaenas, in exhibiting the skeleton of a rhinoceros drowned in the flood, or in discovering the decayed timbers of the ark. This indiscreet union of Geology and Revelation can scarcely fail to verify the censure of Bacon by producing "Philosophia phantastica, Religio haeretica."[80]

That Fleming's worries were more for geology than for the authority of Scripture is confirmed by the number and tone of his

attacks on the Scriptural geologists, who went well beyond Buckland in mixing up Mosaic history with the history of the earth. Sir Charles Lyell's Principles of Geology, published between 1830 and 1833, revived the ideas of Hutton and Playfair that geological change was gradual and cyclical.[81] Causes now in operation could account for all past developments without resort to sudden, violent floods or other cataclysms. Fleming did not agree with everything in Lyell's account, but he stood firmly behind his fellow Scotsman on the interpretation of Genesis. Lyell contended that the Biblical Flood had been local rather than universal. He also acknowledged Fleming's arguments, drawn from the Mosaic account itself, for a non-violent Deluge. More wary of controversy than Fleming, Lyell avoided formulations which would lead him into direct conflict with the clergy, through he confided to another ally, George Poulett Scrope, that he aimed in his book "to sink the diluvialists, and in short, all the theological sophists."[82] Fleming evidently detected Lyell's purpose, warning him that "passing over Moses, as the first of geologists, will of course expose you to not a few suspicions and it may be malediction." In support of his friend, Fleming remarked that Lyell would succeed "in displacing the quackeries of a Bugg or Penn or a Ure, and in introducing Geology to the notice of the British publick under a new and more dignified aspect."[83] Fleming's irritation with the activities of the Scriptural geologists did not lessen with the passing of time. In an article of 1847 about the geology of Edinburgh and its surroundings, he returned to the attack:

> With this class of authors, the best established facts are discarded, the important results of much labour and thought are overlooked, and a spurious system erected in their stead, which can accommodate itself to the standard of a

nursery geology.[84]

Miller, too, had little patience with the Scriptural geologists, even if he has occasionally himself been wrongly described as one, for example by Cosslett (although she applies the label also to the distinguished trio of Chalmers, Buckland and Sedgwick).[85] In First Impressions of England and its People (1847), Miller adopted the interval theory of Chalmers, though he actually associated it with his own parish minister in Cromarty, the Rev. Alexander Stewart. The early history of the Earth was quite irrelevant to man's spiritual condition and therefore was not to be found in Scripture:

> The ferns and lepidodendra of the Coal Measures are as little connected with the truths which influence our spiritual state, as the vegetable productions of Mercury or of Pallas, the birds and reptiles of the Oolite, as the unknown animals that inhabit the plains or disport in the rivers of Saturn or Uranus.[86]

The analogy with astronomical phenomena was a good one, since the persecution of Galileo by the Roman Catholic Church was well-established in Protestant polemic. Fleming had also noticed the precedent in his History of British Animals (1842):

> Are the Zoological and Geological Epochs established as true in science? If those who are qualified to judge shall pronounce in the affirmative, then must every interpretation of that brief portion of the sacred page, inconsistent therewith, be rejected as spurious, and the advocates of error consigned to occupy a page in the History of Prejudice, along with the persecutors of GALILEO.[87]

In this work, Fleming had also put forward a scheme of reconciliation similar to Chalmers'.

Miller liked to refer to the Scriptural geologists as "anti-geologists", a category in which he included William Cockburn, Dean of York, who detected infidelity in Buckland's Bridgewater Treatise and took part in a debate with Sedgwick at the British Association

meeting in 1844. Miller lumped Cockburn with the Puseyites, who were then gaining influence at Oxford, and whose attitude to science was indifferent or even hostile. He also regretted that the English Evangelical Record newspaper had taken Cockburn's side.[88] In 1846, an editorial in the Witness denounced the twin enemies of Tractarianism and Scriptural geology, prompted by opposition in the press to the Southampton meeting of the British Association. The article ended with the ringing words:

> Protestantism is the true religion of science; the right of private judgement, the legitimate counterpart of the inductive philosophy.[89]

Interestingly, Miller later changed his view abut the interval theory, which depended for its credibility on the creation of man and all contemporary species within the Biblical chronology. Immediately before this creation there must have been wholesale destruction of species, one of the 'revolutions' which catastrophists used to account for the gaps between successive geological epochs. Miller became convinced that such a revolution had not taken place. The recent creation of man was entirely non-negotiable; indeed, in 1854, the Witness strongly condemned J. Beete Jukes' Popular Physical Geology for its suggestion that the human period might extend back 30,000 or 40,000 years.[90] In Footprints of the Creator (1849) Miller was already indicating that other living species had a much greater antiquity. He conjured up a picture of a world "several thousand years ago ere the upheaval of the last of our raised beaches", in which there existed a submarine bed frequented by herrings, dog-fish, cod, porpoise, ling, hake and turbot, all contemporary species.[91] He also referred to the five contemporary floras of the British Isles, the fourth dating from "that cold, glacial, post-Tertiary period, in

which what is now Britain existed as a few groups of insulated hill-tops", and the fifth from "a later period, when the climate had greatly meliorated."[92] All this suggests that Miller was radically revising his geological chronology. The new mode of reconciling Scripture and Earth history was to interpret the days of creation, not as literal days, but as indefinite periods of time. The 'age theory' thus replaced the 'interval theory'. As Miller explained in a lecture of 1854:

> All the evidence runs counter to the supposition that immediately before the appearance of man upon earth there existed a chaotic period which separated the previous from the present creation. Up till the commencement of the Eocene ages, if even then, there was no such chaotic period in at least what is now Britain and the European continent; - the persistency from a high antiquity of some of the existing races, of not only plants and shells, but of even some of the mammiferous animals, such as the badger, the goat, and the wild cat, prove there was not.[93]

In the preface to Testimony of the Rocks, Miller stressed that the move from interval to age had come about through his studies of the later geological formations.[94] He had held to the earlier theory (now identified with Chalmers and Buckland) when his practical studies had been limited mainly to the Palaeozoic and Secondary rocks. The lecture stated that the interval theory had in fact become untenable in 1839. The work of Lyell on the Tertiary formations had established that some contemporary species had co-existed with extinct ones, and therefore there had been no global catastrophe prior to the existing creation.

The ages were not of a specified nor necessarily equal length. The Mosaic account was to be considered in the nature of a prophecy, albeit a retrodictive one.[95] Only three of the six 'days' fell into the domain of the geologist: the period of plants, the period of

great sea creatures and creeping things and the period of cattle and beasts of the Earth. These corresponded to the Palaeozoic, Secondary and Tertiary periods, the Biblical account mentioning the most striking features of each. However, the interval theory had separated Scripture and geology more completely and Miller's new strategy was criticised by some Free Churchmen, including the Rev. John Duns, who succeeded Fleming in the chair of natural science at New College. Duns even suggested that some species might have been re-created from one epoch to the next, thus giving an illusory appearance of continuity.[96] Fleming had also adhered to the interval theory until his death, suggesting in The Lithology of Edinburgh that the extinction of species might be the result of the exhaustion of the sun's heat.[97] This had been regenerated at each new creation, the most recent example being described in Genesis.

To understand more clearly the variety of pressures exerted on the Free Church's men of science, it is instructive to look at the views of other Evangelicals on the question of Genesis and geology. The relationship between Scripture and science was in fact a subject of much interest from the beginning of the nineteenth century onwards. In the first three decades, especially, there was a fair sprinkling of locally-produced Scriptural geology.

In the Edinburgh Christian Instructor (1817), 'L.C.' argued that animals had been incapable of hurting one another before the Fall of man.[98] The Fall was sometimes associated also with major physical changes in the Earth's surface. In 1829 in the same journal, 'J.M.P.' was urging that we lived in the ruins of a "once beautiful and happy planet", which had undergone catastrophes both at the Fall and the Flood.[99] The former had given rise to the principal mountain

ranges, the latter had produced secondary mountains. 'H.M.W.' on the other hand, writing in the same year, was prepared to acknowledge that the word 'day' might be interpreted in the non-literal sense, though he added the unorthodox suggestion that crocodiles might be degenerated descendants of earlier sea monsters: 'whales' in the Biblical account.[100] Also in 1829, 'E.N.' blended diluvialism with the interval theory of Chalmers, suggesting that the Creation in Genesis was actually a renovation from a chaotic state but speculating that the deluge might account for irregularities in the direction of strata.[101] Indeed, mountains might not have existed before the Flood. In reply, 'Quisquis' of Dumfriesshire regretted E.N.'s attempt to shroud the Mosaic testimony with "a veil of mysticism, pervious only to the keen eye of learning and philosophy."[102] 'Quisquis' referred to, but did not name, "very eminent geologists" in favour of the accuracy of the Mosaic chronology. Even where a more liberal interpretation of Scripture was accepted, there was often scepticism about the reliability of geological facts. The Presbyterian Review of 1833 was reconciled to a non-literal 'day' and to a transient and tranquil Deluge but expected no corroboration of Scripture from the "uncertain discoveries and loose theories" of geology.[103] The Review also insisted that the Fall was an event of physical as well as moral significance. Before it, "neither the organized material and animal creation nor its rational, intelligent head, bore one taint of physical or moral evil."[104] A similar distrust of geological discovery was shown by the Edinburgh Christian Instructor in 1835, angry about attacks made by geologists upon Revelation.[105] Against Chalmers, the Instructor stressed that geology did not teach us that

the world had a beginning. We knew this only from Scripture. By the late 1830s, there are signs that Scriptural geology was in retreat. In 1837, an article in the Instructor rejoiced that to be a geologist was no longer "almost necessarily to be an infidel."[106] The Instructor adopted the age theory, suggesting that the Creator was now resting from the work of the six 'days'. About the same time, the Presbyterian Review was opting for the interval theory by suggesting that the first verse of Genesis related to "a period, long ere the chaotic state of the earth was fitted for the support of the living creatures which we now see".[107] Even so, another article in the Review of the same year warned of transferring the truth of Scripture "from the rock of its foundation to a quicksand" if any particular theory of reconciliation were chosen as the correct one.[108]

By the late 1830s, the most extreme forms of Scriptural geology had fallen out of favour. A review of Burnett's Natural Theology in the Presbyterian Review of 1839 regretted the author's attempts to use the deluge to account for "all the appearances described by geological writers."[109] Yet it is noteworthy that as late as 1838, the Rev. J. Forbes (of the Established Church and later of the Free Church) was convinced that "there is no truth connected with the history of the globe that is supported by clearer or more ample evidence" than that "a deluge has covered the whole earth, and that the habitable world has been in a state of submergence to the waters of the ocean".[110] The following year, however, the Presbyterian Review observed that "a great many well-intentioned and intelligent persons are greatly too sensitive" on the question of the authority of Moses. The moment that a theory was proposed which seemed to

challenge Scripture they were "instantly on the alert".[111] Later, the Review welcomed Miller's Old Red Sandstone as "the work of a Christian philosopher".[112]

If the Evangelical press was gradually falling into line with the party's leading scientific lights, the work of Miller, Fleming and Chalmers continued to face opposition from other religious groupings, including the Moderate party in the Church of Scotland. Its organ, the Church Review observed in an article of 1836 that geology revealed "proofs of ulterior design, of adaptation of circumstances to the condition of animal life, and the clearest indications at once of a creating and a preserving power presiding over the destinies of the world."[113] More cautious, however, was an item the following year on Buckland's Bridgewater Treatise which regretted the "latitudinarian spirit" in the geologist's "indefinite draughts" upon time.[114] The same year, another article in the Review observed that geological theories were "so different and contradictory as to be totally unworthy of credence" and suggested that the age of the Earth was "the great geological problem of the day."[115] Still greater scepticism was shown in articles which later appeared in Macphail's Ecclesiastical Journal, an organ of the Established Church after the Disruption. In 1851, the journal warned of "rashly dovetailing into Scripture every new and plausible generalization of Geology, which may have soon to be given up as utterly untenable";[116] in 1857 the late Hugh Miller was pilloried for the "unctuous rhetoric" of his Testimony of the Rocks, a work which had been "run after by the wise children of progress."[117] The following year, Miller was again singled out for his belief in a partial deluge, a belief opposed by "historical traditions, ethnological deductions and anatomical

laws".[118] In 1861, Macphail's praised a Mr M'Farlane:

> ... for attempting to stem the adverse, and the evil, current which has set in so strongly, emanating from the geologists, who think that the fundamental and long established first principles of Religion, of Natural Theology in particular, ought to be overturned, because forsooth! of the discoveries, by those Geologists, of the fossil relics of ferocious and abominable monsters, supposed to have existed milleniums [sic] before the first man.[119]

Such a mass of anti-geological sentiment was scarcely balanced by an article in 1856 which adopted the interval theory and praised geology's "irrefragable proof of the falseness of what is called the development hypothesis."[120] Indeed, an article of 1859 opted for an agnostic approach to theories of reconciliation: "we regard all attempts at the discovery of a true theory of reconciliation between geology and the Mosaic account of creation, for the present, hopeless."[121]

The abhorrence shown above to the more alarming species of fossil creatures was shared by William Gillespie, a theological writer (possibly an Evangelical) who deplored the primaeval world of carnage depicted in Miller's Testimony of the Rocks. Gillespie maintained that it detracted from God's perfect goodness to suppose that physical evil preceded the moral evil introduced by man at the Fall, and accused Miller of defending "Gnostical or Manichee" principles.[122] Just as the present races of carnivorous quadrupeds and reptiles were a physical embodiment of human evil, so the "more dreadful monsters of the Coal Measures and of the Oolite" bore a relation to the angels who rebelled under Lucifer.[123] It is noteworthy that Fleming's New College lectures included a discussion of the means of reconciling the existence of death before the Fall with the account of creation given in Scripture.[124] Evidently this

was an objection quite frequently encountered either to geology or to Genesis.

In other areas of metaphysics and theology we find some divergence of view amongst the Evangelical scientists. An example is the plurality of worlds. We have already seen that Chalmers was prepared to come to terms with the belief that other worlds than our own were occupied by intelligent creatures. He may even have been attracted by the theory itself for the substance it imparted to the Biblicial "heavenly host" and for the astonishing perspective it offered on the earth as a unique battleground of good and evil. Brewster was not prepared even to entertain the notion that the theory might be false. His strongest defence of life on other worlds was occasioned by William Whewell's Essay (1853),[125] but before that there are indications that he took the idea for granted. In a letter of 1836 to J.P. Nichol, professor of practical astronomy at Glasgow University, he remarked that it might eventually be possible to discover structures built by the moon's inhabitants, so great would be the improvement in the power of telescopes.[126] Brewster also contributed an article on planetary life to the Monthly Chronicle in 1838 which contained some of the material later used against Whewell.[127]

The publication of Whewell's work led Brewster to ransack the cabinets of science, metaphysics and theology for reassurance that man was not alone in the universe. One of Whewell's arguments against a plurality of worlds was based on the apparently large ratio between the age of the Earth and the span of its tenancy by intelligent creatures. Since the Earth had been without intelligent life for such a long time, Whewell argued, there was no particular

reason to believe that other worlds might be inhabited. By analogy, intelligent beings might be localised in space as they were in time. Brewster countered with the suggestion that the geological timescale might not be all that long after all: "why may He not at different periods, or during the whole course of the earth's formation, have deposited its strata by a rapid precipitation of their atoms from the waters which suspended them?"[128] In any case, the analogy used by Whewell was weakened by the prospect that man would continue to occupy the Earth for many ages to come, "a period equal, or approximating to the period of the Earth's preparation."[129]

Brewster heaped up analogies of his own, between the Earth and the moon, between the moon and other satellites, and between the Earth and other planets. Populating all these bodies in our own solar system, he made the further and more outlandish suggestion (in the book, but not in the earlier article) that the sun was also inhabited.[130] Here Brewster followed an idea of Sir William Herschel's that the sun's heat derived from an outer layer of self-luminous clouds, and that an inner layer protected the inhabitants of a central dark core from the intense heat. The analogy between our own sun and the stars launched Brewster on a mission to populate the whole universe, guided also by a principle of natural theology that the Creator made nothing in vain. Life and matter went together "and when the mind is once alive to this great truth, it cannot fail to realize the grand combination of <u>infinity of life with infinity of matter</u>."[131]

Brewster also claimed Scriptural warrant for the belief, suggesting that the word 'Heavens' could be understood to mean a material creation unless the context forbade it. The plurality of

worlds was thus implied in texts such as Isaiah xiv, 22 where the heavens are "spread out as a tent to dwell in" and in Job ix, 8,9 in which God "spread out the heavens, made Arcturus, Orion and Pleiades, and the chambers of the south." Most strikingly of all it was implicit in Psalm 8, iii, iv: "When I consider thy Heavens, the work of thy fingers, the moon and the stars, which thou hast ordained, what is man, that thou art mindful of him? and the son of man, that thou visitest him?" Here Brewster took issue with Chalmers for supposing the Hebrew psalmist to be ignorant of astronomy.[132] Only if other worlds were inhabited should anyone express surprise that the Lord was concerned about the destiny of our own tiny planet.

Brewster's dispute with Whewell has been analysed by John Brooke, who treats Whewell's position as more problematic for the historian than Brewster's.[133] Brooke is at pains to explain why Whewell, the more liberal of the two in theology, took what seems to be a more orthodox view as far as Christian belief is concerned. Without a plurality of worlds, the Christian did not have to worry about the scope of the atonement for human sin performed by Jesus Christ at the crucifixion. Brewster, by contrast, resorted to some clumsy apologetics which had the effects of the atonement spreading out from the Earth, "the middle planet of the system" (a false assertion and one which failed to deal with the question of life on other planetary systems).[134]

Brooke points out that Brewster completely failed to recognise one of Whewell's chief objectives in writing the Essay. A major factor in the development of Whewell's belief in a unique world was the publication of Vestiges of the Natural History of Creation in 1844. Whewell evidently wished to deprive the author of Vestiges of

one of his arguments against the origin of species by special acts of creation. Robert Chambers, taking advantage of the widely-held belief in the existence of other inhabited worlds, had argued in Vestiges for the implausibility of the Creator's going from planet to planet, furnishing each one with living forms.[135] Whewell's Essay argued that the Earth was unique in its status and in the destiny of its intelligent occupants.

Why was Brewster such a fervent believer in a plurality of worlds, even after Vestiges? Partly, he seems to have been guided by the principle that the Lord made nothing in vain. I have already noticed his preference for natural theology based on living phenomena. He feared that a universe of lifeless matter would actually set astronomy against the design argument: "In peopling such worlds with life and intelligence, we assign the cause of their existence."[136] Partly however, Brewster saw in the infinity of other worlds a source of reassurance about human afterlife. Unlike Chalmers, he did not accept that the inhabitants of other worlds could be in a state of moral perfection. He held that angelic natures could not exist in material bodies.[137] Nevertheless, he appeared to contradict this view by suggesting that the planets were a kind of physicalised heaven. The Christian looked to the stellar systems as "the hallowed spots on which his immortal existence is to run".[138] His book thus mingled a scientific argument about the plausibility of intelligent life on other worlds with speculations about our own destiny. Even when writing in the former mode, however, he felt that the inhabitants of other worlds might be far in advance of the human race:

> What inconceivable and countless functions may we not

> assign to that plurality of intellectual communities, which have been settled, or are about to settle, in the celestial spheres? What deeds of heroism, moral, and perchance physical! What enterprises of philanthropy, what achievements of genius must be required in empires so extensive, and in worlds so grand![139]

Brewster's lofty views of the celestial denizens were shared by another evangelical writer, Thomas Dick. He had been a preacher in the Secession Church before devoting himself to studying and writing about science, and was a self-confessed "stickler for orthodoxy".[140] He was also an admirer of Chalmers, dedicating to him his Philosophy of a Future State, in recognition of Chalmers' "philanthropic exertions to promote the moral and religious improvement of mankind."[141] Like Chalmers, Dick thought that most of the universe remained in its pure, unblemished state:

> It is probable that the greater part of the inhabitants of all worlds are in a state of innocence, or in other words, that they remain in that state of moral rectitude in which they were created.[142]

The theodicy was quite explicit. The effects of moral evil were local and possibly confined only to the Earth. On such a small scale, its occurrence could be explained away:

> Its introduction into the world has doubtless been permitted in order to bring about a greater good to the universe at large than could have been accomplished without it.[143]

Dick did not rule out the possibility that sin had extended its empire beyond the Earth, but he was confident that most of the citizens even of our own solar system remained in a state of Grace. Like Brewster, Dick imagined these unfallen creatures devoting themselves to peaceful and rational pursuits, particularly to science.[144] He was especially appalled at a claim of the astrophysicist Josef Frauenhofer to have discovered a fortification

on the surface of the moon, which implied that "the inhabitants of that globe are activated by the same principles of depravity, ambition and revenge, which have infected the moral atmosphere of our sublunary world."[145] He also combated a suggestion of William Whiston that the comets were fit only to be prison houses for the wicked:

> For anything we can prove to the contrary, some of the comets may be the abodes of greater happiness than is to be found in our sublunary world, and may be peopled with intelligences of a higher order than the race of man. In consequence of the extensive regions through which they move, and the variety of objects which will successively burst upon their view, their prospects of the scenes of the universe will be far more diversified and expansive than those of the inhabitants of the planets.[146]

The writings of Brewster and Dick bring out explicitly the functions of a belief in the plurality of worlds: the theodicy and the need for a material basis to faith in man's existence after death. The theodicy is echoed in an article in the Christian educational magazine, Hogg's Weekly Instructor (1848), which argued that if the Earth were the only inhabited world, this gave Satan far too big a domain.[147] A third function for Brewster and Dick was to allow them free rein to speculate on the kinds of material and scientific progress which could be made in a world untainted by human corruption. As Evangelical Calvinists, they were acutely aware of the effects of sin on our own world. Although both can be found making optimistic predictions for the future of the human race, they knew that progress was likely to be vitiated by man's Fallen condition. Their enthusiasm for the advance of science and technology, coupled with a faith in the power of education and the diffusion of knowledge, could find unbounded scope when discussing the societies of the moon or Jupiter. At the same time these

idealised worlds could serve as models for our own imperfect species to emulate.

Where Chalmers had perhaps kindled an uncertain and flickering glow from astronomy, for Brewster and Dick the heavens were positively ablaze with theological light. "There is certainly, no branch of science better fitted to be made the leading subject of general instruction than that which relates to the planetary and sidereal universe", Brewster told his audience at the Edinburgh Philosophical Institution in 1851.[148] This seemed to contradict some of his remarks made in the 1830s about the organic sciences and their priority in natural theology. However, the apparent contradiction can be resolved once we realise that Brewster increasingly associated astronomy with the phenomena of life, including human afterlife. In chapter seven I also identify the important transitional stage in Brewster's astronomical natural theology associated with the nebular hypothesis.

Fleming's position on the plurality of worlds is not known, but Miller was much less committed to plurality than was either Brewster or Dick. In 1844, the Witness suggested that the knot which Chalmers had sought to untie in the Astronomical Discourses could now be cut, because it was unlikely that other worlds were in fact inhabited by intelligent creatures.[149] The means of depopulating the rest of the universe came from geology, an analogical argument between shortness of time and locality in space similar to that later used by Whewell. It was repeated in Miller's First Impressions of England:

> Mercury, Venus, Mars, Jupiter, Saturn, and Uranus, may have all their plants and animals; and yet they may be as devoid of rational, accountable creatures, as were the creations of the Silurian, Old Red Sandstone, Carboniferous, Oolitic, Cretaceous, and Tertiary periods.

Nevertheless, Miller suggested that the planets might be our future abodes, the Earth being only "the cradle and the nursery" of immortal man.[150] This suggestion was repeated in 1848 in an article on the geology of the Bass Rock. The Earth was not large enough to accommodate all the righteous at the resurrection of the dead.[151]

In 1854, Miller again assessed the balance of probabilities between the cases for and against plurality, judging that Whewell had pressed his argument too far:

> It merely shows, from the extended experience of the earth's history which Geology furnishes, that these conclusions [concerning inhabited worlds] may not refer to the now of the Planetary Universe, but to some period in a perhaps very remote future.

Miller concluded that the astronomical and geological arguments "modify, but in no degree destroy, each other."[152] In other words, there was no way of deciding the case categorically one way or the other. In a subsequent, mainly favourable review of Brewster's More Worlds than One, Miller regretted only some of its geological statements, particularly the attempt radically to shorten the Earth's chronology.[153] Miller reiterated that the other planets might be the future residences of resurrected human beings, including both the saved and the lost. Unlike Brewster and Dick, he considered planets distant from the sun, or very close to it, to be very unpleasant abodes and therefore suitable places for the wicked to be sent. If other worlds were already inhabited, Miller followed Brewster's solution to the problem of the atonement, arguing that its effects could quite plausibly extend beyond the Earth.

The Evangelical scientists did not always agree in other areas of metaphysics. Miller, for instance, did not share Chalmers' admiration for Thomas Brown's philosophy. In a leading article of

1856 welcoming Alexander Campbell Fraser to the chair of logic and metaphysics at Edinburgh University, he denounced both Hume and Brown as antagonists of the Scottish school of philosophy, which held

> ... at least this grand advantage over the opponent school, that all its principles and deductions can be brought into harmony with those of all the other departments of science.

Miller actually seemed to regard Brown as the greater danger than Hume, since he saw Hume as a philosopher reaching conclusions so absurd that they were forever neutralised by the man's "vigorous common sense".[154] Here Miller seems to have been out of step not only with Chalmers but with other Evangelicals. The Rev. David Welsh studied under Brown and became his biographer[155] and the Edinburgh Christian Instructor (1823) described Brown as "our most distinguished moralist and unrivalled metaphysician".[156] Fleming, however, apparently sided with Miller, including in his course of lctures at New College a discussion of the "mistakes" of Hume and Brown on the subject of causation.[157]

Although politically a Whig, whilst Chalmers was a Tory, Miller's social teachings differed little from his fellow Free Churchman. He agreed with Chalmers that pauperism would only be cured, or rather prevented, by moral influences and particularly by Christian instruction.[158] Though opposed to the compulsory provision of poor relief, Miller eventually accepted William Alison's argument that the State must intervene to alleviate the most acute forms of destitution. In the early 1840s Miller recognised that sections of the population were on the brink of starvation. Poverty bred diseases which threatened all classes. Reluctantly, Miller acknowledged that a poor law had become "inevitable" in Scotland.[159] However, he castigated those members of the governing classes who had

frustrated Chalmers' efforts to tackle the problem at its root with his campaign of church extension. Miller identified the State's attempt to stifle the non-intrusionist principle as a further contribution to the increase of pauperism. As the earlier article noted, "in the last age the spirit of anti-pauperism and of anti-patronage were inseparable among the Presbyterian people." Indeed much that was "excellent in the highest degree in the Scottish character" stemmed from the "Scottish Church in its evangelical integrity."[160]

Brewster, also a Whig, seems to have had rather less sympathy for Chalmers' social theory. We noted in chapter three his dislike of Chalmers' church extension schemes, the aim of which was to bring social melioration as well as to spread the Gospel. However, in 1842, Brewster confessed to Chalmers that he had been prejudiced against the church leader's views "from not understanding them, and from entertaining strong opinions on the system of starvation with which the Poor in Scotland have been so severally visited". Brewster looked forward to a time when, if Chalmers' proposals for the moral regulation of the populace were met by the endowment of sufficient churches and the popular election of ministers, "we should have no Poor, and might dispense with a Police force and other restraints upon the Immorality that Poverty engenders."[161]

Although lacking Chalmers' erudition in theology and metaphysics, Brewster, Fleming and Miller shared many of the church leader's interests and goals. Like other nineteenth century scientists, they made use of natural theology to justify the process of scientific investigation. It was also a guarantee of the tranquillising effects of popular scientific instruction. However in

various ways, all three expressed caution from time to time about the facility with which design could be traced in nature. Brewster was unhappy about letting natural theology loose on his own field of scientific research in optics and preferred it to concentrate on easily-grasped subjects in natural history. Indeed, the form of his natural theology varied with the context of its use. Brewster sometimes spoke with the voice of the professional specialist. At other times he was the advocate of science for the masses. Fleming maintained that even in zoology and botany, prolonged and careful study was needed before certain adaptations could be detected with confidence. Miller stressed the need for natural theology to concentrate on the more human features of the Creator's work. He dismissed abstract order in nature as the material only of a cold and brutal deism. Wary of system building, all three emphasised the extraordinary diversity and complexity of natural phenomena.

The affirmation of design did not exhaust Evangelical natural theology. Change and decay were imbued with moral significance. Brewster and Miller also ventured perilously into metaphysics, leaning even more heavily than Chalmers on the discoveries of science in order to refute the eternity and singularity of the world. For Brewster, even Biblical miracles were offered a buttress by geology. There is no evidence that their own Christian beliefs were in need of such support. However, I have shown that Evangelical opinion was some time in catching up with Chalmers' radical views on the opening verses of Genesis, involving as they did not only the enormous lengthening of the age of the Earth but the admission that death existed before the Fall of man. It must have been gratifying to be able to offer the Church some theological compensation in return for

abandoning a literal interpretation of Genesis.

I have shown that Miller was willing to give up the interval theory of reconciliation in the light of new discoveries in the Tertiary formation. This is an important point since it proves that theories of reconciliation were not always immovable weights, formed by religious prejudice, and inevitably shaping the evaluation of all subsequent observation. Indeed Miller could have shored up the interval theory by suggesting, as Duns did, that a re-creation of some species had taken place.

Perhaps the most bizarre theological speculation in which Brewster and Miller engaged concerned the plurality of worlds. Here Brewster took a much less balanced view than Miller (or Chalmers), sharing with Thomas Dick the notion that the planets were oases of peaceful and rational endeavour. Yet for Brewster and Miller they were also the future dwelling-places of the righteous and this imparted a thoroughly religious aspect to astronomy, which Brewster had once regarded as of limited interest to the natural theologian.

In the next chapter, I examine Evangelical reactions to the dissemination of radically different forms of natural theology from those described in the last two chapters.

Chapter Six

NATURE VERSUS REVELATION?

During the first half of the nineteenth century, Evangelical religion faced serious challenges from a variety of forms of unbelief. At New Lanark between 1799 and 1829, Robert Owen, an atheist, used his experience as a benevolent factory-owner to formulate proposals for a society organised into small communities, in which co-operation, not competition, would be the dominant ethic.[1] After attempts to put his co-operative ideas into practice, first in Scotland and then in the United States, Owen was one of the prime movers in establishing the Grand National Consolidated Trades Union in 1833. By this time the paternalism of his early efforts at New Lanark had been replaced by a hope that the labouring classes could destroy capitalism and establish, all at once, the 'new moral world'. The Evangelicals detested Owen's Utopian socialism and parts of Chalmers' Bridgewater Treatise were clearly reacting to such radical proposals for social re-organisation.[2] However, Owen's teachings never attracted a large popular following in Scotland. Nor did he make substantial use of scientific principles, other than a general environmentalist view of character development. Evil was not the result of Original Sin but of the bad living conditions and distorted moral code, engendered by capitalism.

More relevant, because of its scientific character, and more important, because of its huge popularity, was phrenology. This chapter describes its introduction to Scotland, and its subsequent development. It explores Evangelical reactions to a new science,

which arrived from the Continent already tainted with materialism and fatalism. I also discuss the reception of a form of natural theology whose exponents positively delighted in its dependence on inflexible natural laws. A final reason for examining the development and reception of phrenology is the association between the author of Vestiges of Natural History of Creation and leading Edinburgh phrenologists. Tracing the intellectual roots of Vestiges improves understanding both of how the work came to be written and of the way in which the Evangelicals responded to it.

Phrenology was a system of psychology. It originated in Austria in the work of a physician called Franz Josef Gall. Gall's conviction that physiognomy (the art of judging character from the features of the face) could be given a scientific foundation led him to conduct a large number of dissections of human and animal brains, assisted, betwen 1800 and 1813, by his pupil Johann Gaspar Spurzheim. Gall established to his own satisfaction that the brain was divided into 33 faculties or organs, each one associated with a different personality characteristic or skill.[3] Gall's chief interest was in cerebral anatomy, and after the publication of his phrenological system, his reputation continued to be based mainly on his methods of dissection and anatomical research. By contrast, Spurzheim enthusiastically adopted the new science with high expectations of the light it might throw on problems of contemporary philosophy, religion and social reform.[4] By 1814, when he came to Britain, Spurzheim's long association with Gall was almost over.

In his version of phrenology, Spurzheim ranked the faculties in ascending levels of nobility or moral worth; at the bottom of the scale were the propensities, such as amativeness, the faculty of

sexual attraction, and combativeness, the desire of fighting, which were instincts we shared with the lower animals. Next came the sentiments, some of which were also possessed by the lower animals. In this respect self-esteem, love of approbation, and cautiousness differed from the uniquely human qualities of veneration, hope and ideality. A second order of faculties performed the various functions of the understanding or intellect. These were subdivided into organs of knowing, including individuality, form, colouring and locality, and organs of reflecting, including comparison, causality, wit and imitation.

This in essence was the system taken over by George Combe and other British phrenologists. According to the teaching of Spurzheim and Gall, the brain was the organ of the mind and the individual faculties were innately endowed. Each faculty extended inwards from the surface of the brain so that the area of brain surface corresponding to a particular faculty indicated its power or activity. Moreover, the contours of the skull were held to correspond with those of the brain. Thus it was not necessary to inspect the brain directly; examination of the skull was sufficient to establish the individual's capacities and talents. The size of the particular area of the skull was important but it was not the sole factor determining the activity of an organ. British phrenologists maintained that the 'tone' of a faculty could be improved with exercise and education. Phrenology was a guide to the strengths and weaknesses of character, and phrenologists were especially interested in the extremes of human achievement and depravity. A typical phrenological text might contain pictures of the skull of Michelangelo at one end of the spectrum and that of a

notorious murderer such as Burke or Hare at the other. At the personal level, phrenology promised guidance about choosing a career, recruiting servants and selecting business associates.[5] Its emphasis on the particular mental endowment of the individual also signposted new directions for education and for the treatment of problematic groups: criminals, paupers and the insane.

Spurzheim was an able and tireless advocate of the new science until his death in 1832. By this time there were thriving phrenological societies in many parts of the British Isles. Especially important in the history of the movement and for the concerns of this study was the society founded in Edinburgh in 1820. It attracted members from other parts of Scotland and even enrolled a number of 'corresponding members' from abroad. Among the founder members was George Combe, the son of an Edinburgh brewer. Born in 1788, Combe had attended Edinburgh University and qualified as a lawyer. Hearing Spurzheim lecture in 1816, he quickly became an enthusiast for the new philosophy.

Phrenology in Britain achieved both wide popularity and considerable notoriety. Members of intellectual and social elites frequently ridiculed it, whilst it attracted erstwhile outsiders in political, academic or professional life. Large numbers of artisans, merchants and tradesmen became enthusiastic disciples. Cantor and Shapin have, with different intentions, shown this social division between 'insiders' and 'outsiders' to be true of the Edinburgh debates during the 1820s. Cantor sees the arguments between phrenologists and anti-phrenologists failing to make headway because the disputants held incommensurable viewpoints over the correct procedures and facts of a science of mind.[6] He notes only in passing

that phrenology received considerable support from members of the lower-middle and working classes and that establishment institutions, such as the School of Arts, declined to have any links with the new science. Shapin's sociological interpretation of the Edinburgh controversy points out that anti-phrenologists predominantly belonged to elite institutions. Conversely, nearly all phrenologists were 'outsiders'.[7] Very few belonged to the university professoriate, the clergy of the Established Church and the upper layers of the legal and medical professions. Shapin goes on to suggest that this ability to locate phrenologists and anti-phrenologists in different parts of the social map is not mere coincidence. Nor, for that matter, is it the result of any inherent mental weakness on the part of the outsiders who took up phrenology. Even Cantor does not suggest that there was any intrinsic absurdity in the faculty psychology which allows us to dismiss its devotees as weak-minded simpletons. Rather, Shapin argues that phrenology was attractive to 'outsider' intellectuals because it challenged ideas about the mind and brain which formed the prevailing orthodoxies in established institutions. Phrenology was radical both in its assumptions about the nature of the mind and in its method of studying mental phenomena. Briefly, phrenology was the 'not X' to the elite's 'X'.

Similarly, Cooter has demonstrated that, throughout Britain, the new science attracted many members of the medical profession, to whom the empirical nature of phrenology had an obvious appeal. However, the converts tended to be younger and less well-established doctors; in the upper echelons of the profession, the science of Gall found little favour, and was often condemned.[8] Of course, there were exceptions to the claim that phrenologists were 'outsiders'. The

mineralogist, Sir George Mackenzie, for example, joined the Edinburgh Phrenological Society in 1820, despite being a baronet and a fellow of both the Royal Society and the Royal Society of Edinburgh. However, such examples were rare.

In Edinburgh, phrenology provoked scornful attacks by anatomists and by commonsense philosophers. In 1815, the anatomist John Gordon, writing in the Edinburgh Review, pointed out that the surfaces of the bones forming the cerebral cavity of the cranium were not everywhere parallel to one another.[9] This cast doubt on the phrenologists' ability to infer the development of different parts of the brain from the features of the skull. Sir William Hamilton, professor of civil history at Edinburgh University, also turned to anatomy in two anti-phrenological papers delivered to the Royal Society of Edinburgh, in 1826 and 1827.[10] Hamilton concentrated especially on the development of the frontal sinuses, which inevitably created cranial non-parallelism. In 1827, the professor delivered another attack on phrenology, this time to a popular audience in the University. As Shapin emphasises, Hamilton's efforts to undermine phrenology were prompted by the phrenologists' frequently-expressed contempt for the commonsense philosophy.[11] The mental science of the commonsense school depended on the method of introspection, which was difficult and time-consuming to learn. Combe and his associates condemned it for its complexity and lack of practical value. Phrenology, by contrast, was put forward as a simple, demonstrable set of truths, to which all could have access.

The Edinburgh debates did not win converts on either side. Rather, perhaps, they helped to convince the phrenologists that they must mobilise support outside elite institutions if they were to make

progress. Cantor sees the conclusion of the debates over technical issues with Edinburgh academics as the occasion of a change in the character of phrenology. From about 1828, he maintains, the phrenologists began to explore the social implications of their subject. Shapin challenges this, claiming that social issues were intrinsic to the early development of Edinburgh phrenology. It was not a 'pure' science, on to which concerns with political and social reform were later engrafted. However, both historians agree that, during the 1820s, the phrenologists concentrated on defending their system of cranioscopy. In this period they sought to meet the moral philosophers and medical men on their own ground.

Combe's early works, such as his Essays on Phrenology (1819)[12] and his Elements of Phrenology (1824)[13] were mostly concerned with classification and description of the 33 faculties. However, Spurzheim's interest in social reform and the remoulding of human character was shared by many British phrenologists. Phrenology became the basis for educational innovation, for prison reform, and for extension of the franchise. It also became a stick with which to beat orthodox Christianity.

Combe's upbringing conditioned his views on religion and education. One of 17 children, he had suffered an illness in infancy which left him permanently weakened. His parents had mechanically drilled him in the Catechism. At school he had endured more rote learning and also suffered beatings from a brutal schoolmaster. He associated the poverty and unhealthy living conditions in which he had been raised with the gloomy evangelical beliefs of his parents. For Combe, Calvinism came to mean acquiescence in suffering, a surrendering of one's destiny to the mysterious dispensations of

Providence. Phrenology, by contrast, was simple to learn and promised reliable guidance on how to improve one's prospects in life. Its implications for the transformation of education and society also greatly interested him. Combe embraced phrenology as a kind of new religion.[14]

In 1826, Combe began his elaboration of the social implications in a paper to the Phrenological Society on human responsibility.[15] It contained a long discussion of the problem of criminal behaviour and urged that the sentencing of offenders should be motivated by the hope of correction rather than by the desire for punishment. The following year, he circulated privately his Essay on the Constitution of Man, which had formed the concluding part of a course of lectures given by him in Edinburgh in the winter of 1826-7. As Combe remarked in his preface, he had been urged "on the one hand, to publish the views, as calculated to benefit society; and, on the other, to suppress them, as dangerous to its interests to the cause of Phrenology and to my own reputation".[16] Here in embryonic form was the work which later brought Combe fame and notoriety.

The Essay suggested that society could be re-modelled by educating people to conform to the natural laws, which regulated the whole of human existence. It also set forth a related principle: the supremacy of the moral sentiments and intellect. Combe held that, in a properly regulated mental constitution, these superior faculties should be in charge. Most of the human race was at present ruled by various combinations of lower faculties, and this unsatisfactory situation could only be remedied by a prolonged process of education.

Cantor's assertion that a change took place in the character of Edinburgh phrenology is lent some support by noting that these

papers, particularly the Essay on the Constitution of Man, provoked surprise and hostility amongst some members of the Phrenological Society. Opposition focused especially on the allegedly anti-Christian tendencies of Combe's doctrines. According to de Giustino, phrenology "from the very beginning ... contained a sceptical attitude toward the evidence of Christian doctrines and the value of Christianity to society".[17] In Roman Catholic Austria, Gall's researches had fallen under suspicion of materialism and official disapproval finally forced him to leave the country in 1805. In Protestant Britain, the story was somewhat different. De Giustino acknowledges that there were a number of Christian phrenologists who managed to accommodate their cranioscopy to their Christianity (or vice versa). Whilst Spurzheim's doctrine asserted that the brain was the organ of the mind, it did not definitely proclaim the identity of matter and spirit. Some anti-phrenologists, such as Sir William Hamilton, linked phrenology with fatalism and atheism, although this was not the main thrust of his attack, which concentrated on undermining the empirical basis of the new science. If phrenology was from the outset an "ungodly error", as de Giustino suggests, there were undoubtedly many believers who failed to notice when it was first introduced to Britain.

Indeed, a number of works were produced, specifically dealing with Christian phrenology. Examples included Dr John Epps' The Internal Evidences of Christianity, deduced from Phrenology[18] and Henry Clarke's Christian Phrenology.[19] One of the most eminent clergymen to defend the science was Richard Whately, appointed archbishop of Dublin in 1831.[20] However, his theological views were so heterodox that he did little to endear the subject to other

Christians. Even as late as the 1830s, however, some newly-formed phrenological societies won the support of local ministers. In Felix Holt, The Radical George Eliot, herself an associate of Combe, had the English Dissenting clergyman, Rufus Lyon, declare that "phrenological science is not irreconcilable with the revealed dispensations."[21] Whilst noting the existence of Christian phrenologists, de Giustino suggests that their project was a rather unpromising one from the start.

Study of the religious press in Scotland for the 1820s reveals that Evangelical writers tended to defend the science against charges of fostering infidelity. In 1821, the Edinburgh Christian Instructor gave favourable notice to Spurzheim's View of the Elementary Principles of Education:

> Holding his work, therefore, to be the legitimate offspring of the peculiar doctrines which the author advocates, it appears to us to contain the best refutation which could be given of the charges of Fatalism and Materialism which have been brought against his system.[22]

Two years later the Instructor carried a paper by George Lyon, a member of the Phrenological Society, 'On the Harmony of Phrenology, with the Scripture Doctrine of Conversion'.[23] Its author argued that phrenology actually confirmed the doctrine of human depravity by offering evidence that the convolutions of the brain corresponding to the organs of the propensities were larger than those of the sentiments or the intellect. Conversion excited the higher faculties to a proper level of activity. Some mental constitutions were shown by phrenology to be unlikely subjects for conversion but this was consistent with God's acting according to general laws.

In 1826, 6 of the 86 members of the Phrenological Society of Edinburgh were clergymen. One was a congregationalist and the others

were from the Church of Scotland, including two prominent Evangelicals, Robert Buchanan and David Welsh.[24] Welsh, minister of Crossmichael in Kirkcudbrightshire, had been a founder member in 1820. He later became professor of Church history at Edinburgh University and was Moderator of the General Assembly at the time of the Disruption. Buchanan was a vice-president of the Society, and Welsh subsequently became president. As early as 1826, Combe made a very frank avowal to Welsh of his profound scepticism about the doctrines of Christianity, particularly the assertion of man's fallen condition and the belief that Christ died in order to atone for human sin. He explained that he had tested the Bible by the standards of reason "as if it had been a Hindoo or Mahomedan manual of divinity". This had resulted in "a thorough conviction that no evidence could possibly support it as divine revelation".[25] Welsh was surprisingly unshaken by such admissions of heterodoxy. He wrote back to Combe:

> Your two last letters are very interesting & may I trust be useful to me in more ways than one. They contain nothing to give me pain additional to what I have suffered ever since I knew your views to be so far removed from what I conceive to be the truth.[26]

Combe wanted Welsh to enter into a public debate with him about the religious bearings of phrenology. Although his openly-expressed opinions on religion were much more cautious than his private declarations, Combe's views still caused dissension in the Phrenological Society. His most resolute opponent was the lawyer, William Scott, one of the proprietors of the Phrenological Journal, who wrote an essay in reply to Combe's paper on responsibility and later vehemently attacked the Essay on the Constitution of Man. Scott saw in Combe's philosophy a revival of dangerous theories of human perfectibility which had enjoyed popularity in eighteenth

century France.

Scott's reply to Combe on human responsibility received little support within the Society. However, he threatened to continue the argument with Combe, if Combe published the paper in the Phrenological Journal. This worried other members. Already in conflict with Edinburgh's academic establishment, the phrenologists did not wish to be seen to be divided amongst themselves. Combe admitted to Welsh that only Robert Buchanan and James Simpson "went out & out with me".[27] In view of other members' concern, Combe agreed to withdraw the paper. Hoping for a more reasoned harmonisation of phrenology and Christianity from Welsh, Combe complained to his friend that Scott and another opponent, George Lyon, had

> ... taken up the Bible and knocked me on the head with it; saying - "Revelation tells us that Man is fallen & the Earth cursed; & the evidence for Revelation is complete; therefore the bible [sic] is the best refutation of your doctrine of evil springing from a breach of the laws, & of mans perfectibility." This closes the argument with them; for I must either attack the Bible or yield; and they have not philosophy enough to stand a discussion on the Bible.[28]

Welsh occupied a position between Combe and Scott. He confessed that his feelings were "all in favour of his [Scott's] jealousy for Christianity" but thought that Scott exaggerated the distance between Combeism and orthodoxy.[29] However, Welsh regretted Combe's introduction of the doctrine of the natural laws into the lectures on phrenology he gave in 1826-7. Whether or not the two subjects were connected, Welsh felt that it was imprudent to mix them up in this way:

> They [Combe's doctrines] may be intimately connected with it [Phrenology] in your mind or even in reality but they surely are not a part of the science of phrenology itself. Many people would attend a course of lectures on what is

> generally understood by the word Phrenology - who would not attend if they knew that a series of lectures were to be introduced inconsistent with Revelation.[30]

The controversial part of the lectures and its subsequent appearance as the Essay on the Constitution of Man caused greater divisions in the Phrenological Society than had the earlier paper on responsibility. In March 1827, Combe reported to Welsh that some leading members of the Society attending the lectures were alarmed by the principles of the natural laws.[31] Shortly afterwards came news of "a combined & concerted attack" by William Scott and James Bridges amongst others, "not on any point of fact or inference but, on evangelical grounds, on the whole theory". The result was "a regular wrangle ... that lasted for two hours, the most unsatisfactory & disagreeable that has occurred."[32] A little earlier, Combe had also lamented to Spurzheim that Scott, as one of the proprietors of the Phrenological Journal, was preventing him from publishing anything concerning the natural laws and human responsibility.[33]

Clearly, some Edinburgh phrenologists eagerly went along with Combe. His vision of the scope and significance of phrenology was similar to Spurzheim's. Others vehemently opposed the direction which he had taken. Another clergyman member of the Society, Gilbert Wardlaw of Albany Street congregational chapel, informed Combe in 1828 that the "grand error" in his system was "in taking up this present state as a condition which may be explained independently of any connexion with a future & wider state of being."[34]

At this stage the conflict remained private and local to the Phrenological Society. In June 1828, the first edition of the Constitution of Man was published.[35] Before I discuss reactions to its publication, I shall give a more detailed exposition of Combe's

philosophy. In particular, I highlight the contrasts between Combe's views of nature and those of Evangelical Calvinists, including Chalmers.

Combe himself regarded the Constitution of Man as a work of natural theology. Although opponents accused him of resurrecting the ideas of "infidel philosophers of France",[36] he saw them as part of the tradition deriving from Paley. The sympathetic Scotsman newspaper thought his book had "considerable analogy to the Bridgewater treatises".[37] However, it was not only the author's private beliefs about Christianity which distanced him from the Bridgewater authors. I have identified five main characteristics of Combeist natural theology which associated it with deism rather than with theism.

First, nature was held to furnish a complete guide to human conduct. The Combeists used the term 'natural law' to mean both a description of events and a prescription for behaviour. The laws of nature were considered to be divine commands issued by God to his Creation, but the word 'law' was also interpreted in its juridical sense to mean an injunction to man to behave in a certain way. As Combe explained in the Constitution of Man:

> If then, the reader keep in view that GOD is the creator; that Nature, in the general sense, means the world which He has made; and, in a more limited sense, the particular constitution which he has bestowed on any special object, of which we may be treating, and that a Law of Nature means the established mode in which that constitution acts, and the obligation thereby imposed on intelligent beings to attend to it, he will be in no danger of misunderstanding my meaning.[38]

Combe applied the term natural law to any observed regularity whether in the physical, the organic or the moral worlds. In all cases, natural laws were held to have a prescriptive force: for instance,

the law that a heavy body falls to the ground was represented as a prohibition on carelessly climbing high buildings. Such physical laws were considered to have as much moral force as traditional moral laws such as those that prohibited cheating and stealing. Conversely, moral laws were thought to be amenable to the same scientific treatment as the laws of physics. "In this view", wrote Combe, "morality becomes a science, amd departures from its dictates may be demonstrated as practical follies, injurious to the real interest and happiness of the individual, just as errors in logic are capable of refutation to the understanding".[39]

The second tenet of Combeist natural theology was that these natural laws were unchanging throughout time and space. Indeed, the stronger claim was made that they were immutable:

> ... the mode of action described is universal and invariable, wherever and whenever the substances, or beings, be found in the same condition.[40]

The third principle was that the scope for discovering and applying natural laws was unlimited. Even areas which had proved resistant to scientific explanation were not excluded. For example, the Combeists maintained that cholera epidemics were the result of perfectly natural (if hitherto undiscovered) causes, and were not pestilences sent directly by the divine hand.

The fourth principle was that nature was perfect in all respects, attesting everywhere to the wisdom and benevolence of its Creator. This left the Combeists, like other natural theologians, grappling with the problem of evil, producing answers which differed in their degree of optimism. One of the most sanguine was Combe himself, although as he avowed, less so than the writer, lecturer and phrenologist, Joshua Toulmin Smith:

> You carry your views a little farther than I do in regarding the world as containing no evil, but I am so fond of contemplating good that I never object to such ideas.[41]

According to Combe, evil and suffering visited upon the human race were the penalty for disobeying natural laws, both known and unknown. Even apparently inexplicable pain and misfortune could be attributed to violations of laws still undiscovered, and it appeared that only death from old age would remain to afflict the inhabitants of Combe's enlightened state of the future. Where ignorance was not the reason for disobedience, violation of the natural laws could be ascribed to a deficient mental constitution. One of the central doctrines of the Constitution of Man was the supremacy of the moral sentiments and intellect, but by this Combe meant that the moral sentiments and intellect should be the dominant faculties, not that they always were. In all but the very best brains, the lower faculties, such as amativeness, combativeness, destructiveness and acquisitiveness, would often triumph over the higher, with evil results. This in turn raised the question of how such deficient mental constitutions came to exist at all. Combe's answer was that man paid a price for the ability, as a species, to amass knowledge. Even if men had been created with powerful and well-balanced faculties,

> ... their first movements as individuals would have been retrograde: that is, as individuals, they would, through pure want of information, have infringed many natural laws, and suffered evil; while, as parts of the race, they would have been decidedly advancing.[42]

Combe felt that science would be a worthless pursuit in the absence of a just and benevolent system of nature:

> On the system of the fall and things being cursed what motive have we to prosecute science? John Campbell was quite consistent as a Christian when he said he saw no use of any other knowledge but the Bible. If things be wrong,

> the more we know the more we shall suffer; for we shall continually be running against spikes; Benevolence will be transfixed by one ultimate principle of creation; and Conscientiousness impaled on another. Whereas if everything has a right principle in itself and a right relation to everything else, how delightful and beneficial to extend our researches into such a field![43]

According to Combe's theory of heredity, the power of these superior faculties could decrease or increase over several generations, depending on whether or not their organs were exercised. Combe subscribed to the theory of the inheritance of acquired characteristics, warning that the children of drunken or immoral parents would enter the world with deficient moral and intellectual faculties. In this way, each succeeding generation would inherit a progressively inferior mental constitution. On the other hand, exercise of the higher faculties would be rewarded by a progressive improvement in the quality of future generations.

The fifth principle was that nature was advancing towards higher and more complex forms of organisation. Amongst material incorporated for the first time into the second edition of the Constitution (March 1835) was Combe's professed preference for the view that

> ... the world contains the elements of improvement within itself which time will evolve and bring to maturity, it having been constituted by the Creator on the principle of a progressive system, like the acorn in reference to the oak.[44]

In the fourth edition (1835), this had been rephrased as follows:

> ... the world, including both the physical and moral departments contains within itself the elements of improvement, which time will evolve and bring to maturity;[45]

Once again the Combeists sometimes equivocated about the inevitability of this process in relation to human society. As we

saw above, they threatened that a natural process of deterioration would occur if the motor of progress were not set in motion. In the world of non-human nature, they expressed no qualifications whatsoever:

> Physical nature itself has undergone many revolutions, and apparently has constantly advanced. Geology seems to shew a distinct preparation of it for successive orders of living beings, rising higher and higher in the scale of intelligence and organization, until man appeared.[46]

Combe, guided by the tolerant Welsh, had been careful in the first edition of the Constitution to say as little as possible about Christian doctrine. Welsh counselled Combe:

> ... if you publish I would with deference suggest that you should make no allusion to the Bible or to a future state at all. Come forward as Smith & Stewart & Brown did and let people draw their own conclusions.[47]

Combe added a few quotations from orthodox natural theologians. On the first characteristic identified above - the ability of nature infallibly to reward good behaviour and punish evil - Combe quoted the words of Adam Sedgwick:

> If there be a superintending Providence, and if his will be manifested by general laws operating both on the physical and moral world, then must a violation of these laws be a violation of his will, and be pregnant with inevitable misery.[48]

Paley provided help in tackling the problem of evil. All of nature's contrivances were directed towards beneficial purposes.[49]

Combe had initially been cautious, but with the passing of time, his declarations on Christian doctrine, notably on man's fallen condition, became bolder. The fourth edition of the Constitution carried, for the first time, the following assertion:

> Theologians who enforce the corruption of human nature, would do well to consider whether man as originally constituted possessed the organs of these propensities

> [combativeness and destructiveness] or not. If he did possess them, it will be incumbent on them to show the objects of them in a world where there was no sorrow, sin, death, or danger. If these organs were bestowed only after the fall, the question will remain to be solved, whether man with new organs added to his brain, and new propensities to his mind, continued the same being, as when these did not form parts of his constitution. Or, finally, they may consider whether the existence of these organs, and of an external world adapted to them, does not prove that man, as he now exists, is actually the same being as when he was created, and that his corruption consists in his tendency to abuse his faculties, and not in any inherent viciousness attributable to his nature itself.[50]

However, there remained limits to the extent of the Combeists' heresy, or at least to their willingness to admit it publicly. This was true even in the 1840s, by which time the phrenological movement had become predominantly deistic and anti-clerical. In 1842, there were heated exchanges at the fifth session of the Phrenological Association (a loosely-knit body bringing together phrenologists from all over Britain). In his introductory address, William Engledue declared his belief in the doctrine of materialism.[51] A number of members of the Association immediately resigned. Others, including Combe's Edinburgh associate, James Simpson, issued a declaration regretting Engledue's statement and stressing that the immateriality or materiality of the mind had not yet been settled.[52]

Replying to Combe's Essay, William Scott tried to show that Combe's doctrine of the natural laws was a mystification of commonsense knowledge. Instruction in the laws of anatomy and physiology, as recommended by Combe, could not help individuals to any better understanding of their relationship to their physical and social environment:

> Those who are most profoundly acquainted with them, [the sciences of anatomy, physiology etc.] only arrive at a knowledge of what is wholesome or unwholesome, nutritive

> and digestible, or the contrary - of what contributes to health, and what does not - by the same means that the most ignorant nurse or peasant arrives at it - by observation and experiment.[53]

Scott rejected the hierarchical view of the faculties. The higher sentiments could be just as much directed towards selfish ends as could the lower. Conversely, the lower propensities such as philo-progenitiveness (the love of one's offspring) might incline to acts of utter disinterestedness. Scott also challenged Combe over his claim for the uniformly benevolent character of nature's arrangements:

> Mr Combe can never get rid of the unquestionable fact that the animal creation are constantly suffering evils of the most appalling description, which they are altogether incapable of avoiding. In most cases, the highest enjoyment of the one is attended by the laceration, destruction, and death of another.

Scott made it clear that he parted company not only with Combe but also with the widely-respected Paley over the condition of the lower species:

> In some cases we may admit with Paley that certain contrivances for producing pain and death, "are directed to beneficial purposes", if we will, like him and Mr Combe, confine our view to one side of the picture, and shut our eyes to the other.[54]

Scott did not temper this dark and hostile image of nature with much reforming optimism when he turned his attention to the natural laws of human society. His attack on Combe's polarised view of the natural and the social worlds was two-pronged. He tried to illustrate that the condition of the lower animals was not one of universal happiness, but he also wanted to show that Combe erred in representing man in his present state as universally miserable. Scott did not minimise evil and suffering but maintained that man's existing mental constitution was evidence of adaptation. According

to Combe, in man's present, largely unenlightened condition, the supremacy of the moral sentiments and intellect was perpetually usurped by the lower faculties. Man's mental constitution was therefore in a state of disorder. Scott stood Combe's theodicy on its head. The predominance of the lower faculties was precisely because of man's moral rebellion at the Fall, and, as such, represented a state of adaptation to his present condition. "This being the case," wrote Scott, "it was important that that class of faculties, the use of which is the most necessary for the preservation of the individual and of the species, should rather predominate."[55]

In administering an antidote to Combe, Scott manifested a conservatism far deeper than Chalmers'. His natural theology had only a remote kinship with the harmonious, happy universe of Paley. Unlike Chalmers, he offered to the lower classes little prospect of rewards in return for obedience to social laws. Pauperism he held to be

> ... a necessary concomitant of wealth, and a necessary condition of a part of our race, tending upon the whole, to useful and beneficial ends, both with reference to the poor themselves, and to the ranks above them.[56]

Scott set aside the potential value of education, evidently resigned to living in a society in which large numbers of people lived in a state of extreme deprivation. Periodic hunger would provide them with the only effective incentive to work, and keep in check the activity of their lower faculties. This was a much more pessimistic form of the Malthusian law of population than the version enunciated by Chalmers.

Scott's exchanges with Combe were, at this stage, confined to

the Phrenological Society of Edinburgh. At first, the religious press seems to have taken very little notice of Combe's book. Perhaps clergymen hoped that Combeism would be a passing fad and, certainly, initial sales of Combe's book were not spectacular. The first edition sold 1500 copies and the second edition was not published until March 1835. In 1833, a new adversary appeared. In the Edinburgh Advertiser, a correspondent calling himself Philomathes attacked the "barbarism" of the phrenologists' programme: "a system more degrading to a rational being never solicited the attention of the world."[57] Philomathes was appalled by the content of Combe's recent lectures, finding in them "second-hand philosophy", "bad logic" and "bad taste". He was also disgusted by Combe's suggestion that females should be taught anatomy and physiology, a recipe for spreading "mental pollution".[58] Indeed the new philosophy was unChristian, resting all its faith on natural theoloy and setting aside the need for a separate Revelation. Philomathes - who may have been William Pyper, a teacher of Latin in the Edinburgh High School - was perhaps mainly interested in defending the value of a classical education against the contempt displayed by the phrenologists for "useless learning". However, he anticipated the later attacks made by the Evangelical party.

In 1835, the phrenological pulse began to quicken, thanks to a bequest from William Ramsay Henderson, the wealthy son of an Edinburgh banker, who died in 1832. The Henderson trustees contributed towards reducing the price of 2200 copies of the first and second editions of the Constitution. They also helped to finance a cheap People's Edition, the first 2000 copies of which sold out in ten days.[59] By March 1, 1836, 12,000 copies of the People's Edition

had been sold, by October, 32,000. A further factor which helped to spur Combe's opponents into action was his decision to stand for the vacant chair of logic and metaphysics at Edinburgh University. The other candidates were Sir William Hamilton, who represented the Moderate tradition in the commonsense school, and Isaac Taylor and P.C. MacDougall, who had Evangelical support.

The ecclesiastical press began to fire off regular salvoes against Combe's philosophy. The Constitution of Man was condemned for being "strongly impregnated with materialism",[60] and "subversive of the first principles of Christianity".[61] Among the recurring objections were claims that Combe had subverted the doctrine of man's fallen condition. He had also denied the efficacy of prayer and the reality of a future state of existence. He was attacked both for taking too optimistic a view of human potential and for being too pessimistic. Whilst Evangelical reviewers argued that not all men could ever be rendered wise and virtuous even in the lapse of centuries, they also condemned Combe's gloomy assumption that large portions of the human race, principally in Africa and Asia, were rendered unfit by their mental constitutions for receiving the benefits of Christianity.[62]

Despite its disunity on other issues, the Church of Scotland seems to have been united in its opposition to Combe's theories. Moderate periodicals also carried refutations, although the more prolonged and fervent opposition came from the Evangelical side. The most thorough attempt made by the Evangelicals to defeat Combe was by recruiting William Scott to write a reply to the Constitution of Man. Welsh and Buchanan apparently had been approached first but had declined.[63] Scott had written to Combe in 1828 demanding an

announcement in the Phrenological Journal that it was to be a vehicle for new principles founded on the natural laws.[64] By 1836 he had sold his stake in the Journal and left the Phrenological Society.[65] His reply largely recapitulated the points made in his earlier pamphlet exchanges with Combe. He accused Combe of denying both the Fall and a future state of existence. The doctrine of the natural laws was dismissed as exaggerated in its claims for the practical value of anatomy and physiology and dangerously false in treating physical laws as of equal importance to moral laws. Combe's picture of a well-balanced mental constitution was also unacceptable. Scott disputed the suggestion that the faculties were in a constant state of contention:

> These, which may be called the savage propensities of our nature, are common to us with the beasts of prey, who hunt, surprise, and destroy their game nearly in the same manner as man. Low as they may be ranked in the scale of our faculties, they are not merely necessary to the existence, but, in a certain extent, to the greatness and power of the human race.[66]

The title of Scott's work - The Harmony of Phrenology with Scripture - indicates the strategy that was characteristic of nearly all religious attacks in Scotland on the new philosophy. Invariably, an attempt was made to prise away phrenology from the unpleasant social and theological implications drawn from it by Combe and his associates. Critics separated phrenology - the investigation of human character and potential by study of the faculties on the surface of the skull - from the doctrine of the natural laws. In some cases this may have been merely a matter of sensible tactics. The faculty psychology was a new science which should be given time to establish itself. Only if shown to be empirically false should it be abandoned. However, even at this stage, some opponents of Combe

continued to be favourably disposed to the science of Gall. 'Verus', who replied to Philomathes in the Advertiser, attempted to divorce the psychology from the social theory. Denying that phrenology was unChristian, he lumped Combe's principles with those of the liberal school of French philosophers, which were not connected with phrenology at all.[67]

"The evangelical disciples have abandoned the Society, given up the Journal, and denounced me as a dangerous infidel", Combe lamented in November 1831.[68] Shortly before, Welsh had resigned the presidency of the Society. The immediate reason for his decision was the Society's refusal to allow discussion of theological topics "which could not be supported by an appeal to facts in nature, and to logical deductions from them."[69] In 1832, Combe complained to Sir George Mackenzie of the pressure on Welsh from Evangelical brethren:

> The small minds extinguish his usefulness by pointing out his want of conformity to them, & they afford an unanswerable argumentum ad hominem, which a churchman cannot answer. Our friend Dr David Welsh is an example. If he had been a layman, he would have been with us. As it is, he is paralysed.[70]

According to his biographer, Welsh continued afterwards to believe in the basic tenets of phrenology.[71] He was not alone. "The only thing that is really humiliating is the wretched figure that the Phrenologists [sic] cut on the occasion", Combe complained to his brother, Andrew, in July 1836, shortly before the contest for the logic chair:

> Dr. Welsh, George Monro, the Rev. Thos. Irvine, John Burn Murdoch, John Anderson Junr. J.F. Macfarlane, & the whole set of them turn tail, like poltroons, or desert & abuse me & obstruct the cause.[72]

The Moderate party in the Church added its denunciations of the Constitution of Man, although the Church Review's article was unusual

in also attacking the basis of phrenology itself. The writer felt that it was too new a science for any scheme to be constructed for reconciling it with Scripture. Scott's efforts were thus set aside, and phrenology in general was castigated for its "false philosophy, pernicious tenets, and daring heresies".[73] That this was an untypical strategy is indicated by the note inserted by the Review's editor regretting that the writer had done "something less than justice to the merits of Mr. Scott".[74] The Scottish Guardian also felt that the article was "both unreasonable and inconsistent".[75]

Combe, in preparing for the contest for the chair had made some efforts to appease clerical opinion. The silence of some leading divines in the past was construed as a sign of approval for his system:

> Dr. Chalmers published his Bridegwater Treatise several years after my work The Constitution of Man had appeared, and although the subjects in his book and mine are closely analogous, he has stated no objection whatever to my views, which is quite inconceivable if he had regarded them as dangerous and unfounded in nature, and been prepared to refute them.

Similarly, the failure of another Evangelical divine to condemn Combeism was interpreted in the most favourable manner:

> Allow me, in conclusion, to draw your attention to the fact, that the late Rev. Andrew Thompson attended a course of my lectures on phrenology in 1822 or 1823, and survived the publication of "The Constitution of Man", a copy of which I presented to him, for nearly three years; and although he conducted the Christian Instructor, and was a zealous, ready, and powerful writer, vividly alive to the purity of the faith which he espoused, yet he never published a word against that book.[76]

Nevertheless Combe complained that the clergy "preached & ranted" against him during the run-up to the election.[77]

From the Dissenting Churches, a rather different reaction was elicited during the contest. Indeed, Combe succeeded in attracting

testimonials from a few of their clergymen. No clergyman of the Established Church obliged him in the same way, even Welsh declining to provide one when asked.[78] The most distinguished Scottish cleric to come to Combe's aid was Alexander Duncan, professor of pastoral theology to the United Associate Synod. Although Duncan admitted to doubts about Combe's theology, he was not convinced that the new creed subverted the doctrine of the Fall. Indeed the phenomena dealt with in the Constitution of Man were

> ... no more inconsistent with human responsibility or favourable to materialism, than other phenomena of our physical constitution, long known, and universally-admitted.[79]

Combe was also gratified by a review in a Secession magazine which, whilst regretting its unsound theology, praised the valuable truths contained in his book.[80] It was therefore possible for devout Christians to admit the practical value of Combeist teachings despite an abhorrence of the metaphysics on which they were based. This limited degree of clerical support did not save Combe from defeat; Hamilton was elected and Combe came bottom of the poll. It was his first and last attempt to secure a university chair.

In Edinburgh, Combe gathered around him a circle of sympathisers with the new philosophy. Not all of them were members of the Phrenological Society though all were, in varying degrees, favourably disposed to the faculty psychology. To avoid confusion with phrenological opponents of the Constitution of Man, I refer to members of Combe's circle as 'Combeists' or 'phrenological secularists'. Opponents often referred to them simply as 'phrenologists'. With the passing of time, such a conflation of terms was increasingly justified. The Christian phrenologists failed

to emerge as an organised movement and the dominant character of British phrenology from the mid-1830s was deistic, anti-clerical and politically reformist. However, the phrenological movement was subject to divisions and disputes, especially between the London phrenologists such as John Elliotson and Combe's Edinburgh group. It is therefore useful to have a specific term for those who followed Combe's teachings. Combe's associates included his brother, Andrew, a distinguished physician, James Simpson, an advocate, William Hodgson, a lecturer on political economy, John Pringle Nichol, an astronomer, William and Robert Chambers, who ran a publishing firm, and Charles Maclaren, editor of the Scotsman. All supplied Combe with testimonials when he stood for the logic chair.

Trained in medicine in Edinburgh and Paris, Andrew Combe began to practise in the Scottish capital in 1823.[81] In the same year, he helped to found the Phrenological Journal and defended phrenology before the Royal Medical Society. Author of works on mental disease and physiology, he also contributed regularly to the Phrenological Journal and was elected president of the Phrenological Society in 1827. In 1838, he received one of the most prestigious appointments ever to go to a phrenologist, that of physician extraordinary to the Queen in Scotland.

Simpson's father was a Church of Scotland minister but like Combe, the younger Simpson had rejected a strict Presbyterian upbringing.[82] Trained as an advocate, he joined the Phrenological Society in 1823 and helped to found the Phrenological Journal. In 1834, Simpson's, The Necessity of Popular Education, was published, containing proposals for non-sectarian schools and for curriculum reform. William Hodgson studied at Edinburgh University and lectured

on education, literature and phrenology in Edinburgh and in Fifeshire before becoming in 1839 secretary of the Liverpool Mechanics' Institution.[83]

J.P. Nichol had originally intended to go into the ministry, and while at Aberdeen University had passed the divinity hall as well as studying mathematics and physics. Afterwards, suffering what the Dictionary of National Biography calls "a change in his theological opinions", he became a schoolmaster instead.[84] He was successively headmaster of Hawick Grammar School, Editor of the Fife Herald, headmaster of Cupar Academy and rector of Montrose Academy. In 1835 he moved to Edinburgh. His connection with Combe's circle is indicated by a notice in the Scotsman of a welcome dinner at which James Simpson was in the chair and Robert Chambers acted as croupier.[85] Combe had recommended Nichol to the Edinburgh Philosophical Association as a lecturer in astronomy and geology,[86] a favour which Nichol returned the following year (1836) by giving Combe a testimonial for the logic chair. Nichol was diffident about styling himself a phrenologist, because he felt that his knowledge of the subject was inadequate. Nevertheless, he praised Combe for the "striking lights which he has succeeded in throwing on the most difficult and important department of human inquiry".[87] In 1836, Nichol became professor of practical astronomy at Glasgow University.

Largely self-educated, Robert Chambers had written a number of antiquarian works such as Traditions of Edinburgh[88] and Scottish Ballads and Songs.[89] With his brother, William, he also produced Chambers' Edinburgh Journal, and more substantial pieces of cheap educational literature such as Information for the People and Chambers' Educational Course. Their desire to avoid controversial

subjects caused some reluctance to publish phrenological material in these works, despite encouragement from Combe. Robert Chambers avowed to Combe in 1833 that he was not "altogether ignorant of phrenology, or altogether a sceptic." Indeed, "if I had been the Earl of Bridgewater, and seen your masterly little volume [the Constitution of Man] I would have given my thousand pounds to you, and spared any further writing upon the subject."[90] In 1835, the brothers published the People's Edition of the Constitution of Man. The same year Chambers wrote enthusiastically to Combe:

> We [William and Robert Chambers] concur in feeling the greatest respect for phrenology as having been the means of applying to mankind a system of mental science which may be the means of greatly improving their condition. We also concur in feeling the greatest respect for yourself as the first existing expositor of that science, and the individual who has been most successful in applying it to the concerns of life. So much have I in particular been impressed with the truth of the metaphysical department of the science, and with your singularly excellent work, the Essay on the Constitution of Man, that, in writing upon human nature, I cannot now do otherwise that [sic] employ this philosophy both as a system of mind and of morals.

Chambers continued to be cautious about introducing phrenology into his firm's periodicals. In the same letter he declined to take "any other more obtrusive means of expressing adherence to the phrenological metaphysics" while promising to acknowledge phrenological sources of ideas.[91] Chambers' testimonial for Combe, stressed the harmony between phrenology and Christianity and the groundlessness of accusations of materialism which had been made against the science.[92]

Charles Maclaren founded the Scotsman in 1817 as a Whig newspaper advocating religious freedom.[93] He was also a keen geologist and edited the sixth edition of Encyclopaedia Britannica. As early as 1827, Combe noted Maclaren's enthusiasm for the doctrines

of the natural laws[94] and the Scotsman was afterwards a staunch supporter of the Constitution of Man.

The existence of links amongst some of the members of this circle is confirmed by an item in Tait's Edinburgh Magazine in 1849 which noted that "the brothers Chambers, Mr. James Simpson the Advocate, and Mr. George Combe, emerge on our notice in a group."[95] In The Castes of Edinburgh (1861), John Heiton devoted a chapter to the "Minute Philosophers", whose "grand text-book" was the Constitution of Man and who were described also as "vestigearians" and "worshippers of nature".[96]

Combe and his circle set about mounting a counter-attack to the Evangelical assaults. Combe was reluctant to give Scott's work any additional publicity by replying to it himself in detail[97] but he later gave his blessing to an answer written by the botanist, Hewett Cottrell Watson, who had been converted to phrenology while studying at Edinburgh University. His work contained a catalogue of logical errors and misrepresentations in the preface and first chapter of Scott's book. It also defended Combe's claims for the inherently progressive character of the natural order.[98] Shortly afterwards, J.P. Nichol produced a searing attack on Scott's work for the Scotsman. Arguing that Combe's philosophy was perfectly in harmony with Revelation, Nichol maintained that the clergy opposed it because it brought into view "THEIR DUTY, to join with their fellows in the effort to work out a large and generous civilisation." He poured scorn on Scott's Harmony and was unable to find "one solitary instance in which an independent journal or review has signified the remotest approval of it." On the other hand, it had received "the bitter and brawling acclaim" of all the Church journals.[99]

So far I have discussed the controversies about Combeism principally as debates about theology. However, it is important to recognise the practical contexts in which Combe's philosophy was used. A very important issue between the Church and Combe's party was the control of education. Since the Reformation, Scotland had been remarkably successful in providing education to most of its citizens. The foundation of the system was the parochial school, the inspiration for which came from the Church of Scotland's First Book of Discipline, which envisaged a school in every parish and compulsory education for all who could benefit from it right up to university level.[100] Reality never matched these high ideals but they were never entirely forgotten. The literacy of the Scottish peasant was a characteristic often noted by writers even as late as the fist quarter of the nineteenth century, when the system was in decline. There was a close link between school and church in the parochial system. The kirk session, assisted by the heritors, inspected the schools and tested the children in their Catechism. The Bible was used as a reading book. Indeed, the high importance accorded to having a literate population owed a great deal to the Calvinistic emphasis on the right of private judgement and the ability of each man and woman to read and interpret the Scriptures for him- or herself.

In the early nineteenth century, Scotland's educational system began to deteriorate. Teachers' salaries had barely risen at all in one hundred years, so that an occupation which once brought at least a comfortable living was now unattractive. Saunders notes that in the early nineteenth century the income of a teacher was often below that of a skilled artisan.[101] The quality of the teaching tended to

decline. The expansion of the population, and especially the growth of industrial towns, put further pressure on the already deficient system.

The population of Glasgow grew from 77,000 in 1801 to 202,000 in 1831, of Paisley in the corresponding period from 31,000 to 57,000, of Dundee from 27,000 to 45,000. The growth of Edinburgh was less spectacular than Glasgow's but still rapid: 66,000 in 1801 to 136,000 in 1831.[102] By the 1820s, the effects of these changes on the level of public educational provision were widely recognised. Both Combeists and Evangelicals acknowledged the extent of the problem, which was aptly summarised in the title of a pamphlet by the Rev. George Lewis, editor of the Scottish Guardian: Scotland a Half-Educated Nation.[103]

It was in the populous cities and particularly amongst the children of manual workers that the inadequacies of the system were most apparent. In the enormous Barony parish of Glasgow, Lewis indicated that perhaps only one in 26 of the children of school age was at day school and a mere one in 17 attended day or evening school. Thomas Chalmers did not underestimate the extent of the problem:

> In the grievous defect of our national institutions, and wretched abandonment of a people left to themselves, and who are permitted to live recklessly and at random as they list - we see enough to account both for the profligacy of our crowded cities, and for the sad demoralization of our neglected provinces.[104]

James Simpson's view of the dominant passions of the lower orders was similar to Chalmers'. Indeed, he was even more pessimistic:

> The working man rarely knows how to better his lot in life, by rational reflection on causes and consequences, founded on early acquaintance with the simpler principles of trade,

> the state of particular employments, the legitimate relation between labour and capital, and between labourer and employer, the best employment of surplus earnings, the value of character, the marketable importance, to say no more, of sober and moral habits and intelligence; in short, on any practical views of the circumstances which influence his condition. On the contrary, he is the creature of impressions and impulses, the unresisting slave of sensual appetites, the ready dupe of the quack, the thrall of the fanatic, and, above all, the passive instrument of the political agitator, whose sinister views and falsehoods he is unable to detect, and who, by flattering his passions and prejudices, has power to sway him, like an overgrown child, to his purposes of injustice, violence, and destruction.[105]

In 1812, a general strike of handloom weavers took place throughout Scotland in an attempt to maintain wages in the industry. The weavers were defeated, but shortly afterwards, organised unions began to make an impact in other industries such as coal-mining. An economic depression and rising unemployment in Britain led to an upsurge of radical political activity in 1819-20. In 1819, the Peterloo Massacre occurred in Manchester. Riots and mass meetings took place in Paisley and Glasgow, and 60,000 workers were estimated to have obeyed a call for a national strike. Although the agitation was easily contained, the 'Radical War' strengthened fears that political unrest as well as moral indiscipline amongst the labouring classes threatened the comfort and safety of their superiors.[106] Like Simpson, the Evangelical, David Stow, sounded a warning about the possible political consequences of a continuing lack of educational provision:

> Have the mass of the working population in this country received sufficient religious and moral training to regulate them in the event of a famine, or extreme stagnation of trade? Let the legislature solemnly look to this, and answer the question.[107]

Though there was general recognition of the problem, there was bitter disagreement about how it should be tackled. Lewis and his

Evangelical colleagues were firmly committed to an extension of the existing parochial system. Although Lewis held that it was the duty of government to provide schooling to the rising generation, parish rates and government grants were to be in the hands of the minister and kirk session in each parochial unit. The machinery for supervising and inspecting the schools already existed in the General Assembly and its education committee. Even in enforcing attendance at schools, the civil authority was to be given no power. Lewis felt that compulsory attendance would be an unattainable goal in the cities. His main mechanism for securing regular attendance was the traditional moral pressure of the kirk. Legal sanctions, he believed, would not carry public support. As to the curriculum, secular learning and moral training, although important, were not to exclude a thorough grounding in "the great principles and doctrines of the gospel."[108]

Radical opinion wished to exclude the Church from involvement in education. The goal was a 'national' scheme of education: centrally funded and completely independent of any religious denomination. In Scotland Combe and his disciples were amongst the most vociferous supporters of such a system. Throughout the 1830s and 1840s they campaigned fervently, although unsuccessfully, on the issue in the columns of the Scotsman, in public meetings and by trying to influence M.P.s. One of their chief difficulties was, as de Giustino notes, that there was a reluctance on the part of national politicians to take up the issue with any marked enthusiasm.[109]

In the debate over the control of schools, the Combeists made use of a number of distinct arguments. The Established Church's defence of its continuing supervision of the parish schools depended

for its strength on the value of a Christian education based on teaching from the Bible. The phrenologists set out to show both what was missing from the present system and what was superfluous. Their criticisms did not relate only to religious instruction. They were impatient with other forms of 'useless learning' including Greek and Latin and were against excessive reliance on all rote learning methods. They also argued for more scientific instruction.

Simpson deplored the parish schools' failure to provide the children of the manual-labour class with anything more than "reading, writing and ciphering", leaving out the study of human nature and of man's relationship to the rest of creation.[110] Genuine moral training, he alleged, was non-existent in these schools, despite their religious superintendence. Simpson's curriculum for elementary education (for children aged between 6 and 14) was much wider than had traditionally been offered, including arithmetic, writing and drawing, an introduction to the main natural sciences and, for the older children, British government and political economy. The whole curriculum was to be suffused with the light of natural theology. With a characteristic outburst of radical empiricism, Simpson declared that the works of God were not the preserve of philosophers alone but should be taught to "EVERY SANE PERSON" in youth.[111] Above all, education should contain a strong element of moral training, in order to instil habits of goodness, justice and piety.

Combe similarly lamented the schools' limited curriculum of reading, writing, arithmetic, geography, the Catechism and "in some a little algebra and mathematics". What was needed was a good grounding in "Causation".[112] By this, Combe meant the principles by

which God governed the world, principles which he believed to be invariant and benevolently adapted to man's welfare. Since the natural laws, physical, organic and moral, were all intimately related to human happiness, they were all worthy of study in schools. Combe admitted that it would not be possible to teach all the arts and sciences in the same depth and to the same extent as in universities. However, he deprecated the Church of Scotland's alleged lack of interest in introducing any science teaching into the parish schools.

Discussions of religious instruction required a more circumspect approach. As we have already seen, the Combeists were anxious to avoid accusations of atheism and materialism, and therefore shunned any direct attack on the truth and validity of Scripture. Instead, they advanced four arguments for breaking the link between school and Bible. The arguments were progressively stronger but stopped short of the most outrageous heresy. The first was that the Bible was not intended to teach secular subjects. The second was that Bible teaching need not be provided during school hours; instead the parents could be left to decide what Scriptural instruction the child should receive and who should provide it. The third was based on the metaphor of the two books - Nature and Revelation - by which God had revealed His attributes and commandments to mankind. Thus religious instruction (from the Book of Nature) could be included in the curriculum even though the Bible were excluded. The fourth argument, and the most controversial, was that the Book of Nature was preferable to the teachings of Scripture.

The first argument about the purely religious content of the Bible enabled the Combeists to condemn its use as a general reading

book. As one critic complained of the Glasgow Infant Schools, which were run by the Evangelicals of the Established Church:

> A large Bible is placed on a stand on the floor; it is the only book in the school; and it is treated as the only book in the world - with no small risk of becoming an object of superstitious regard; while the error is inculcated, or, at least, left to take root, that there is no human knowledge which is not obtained from the Bible - that the Bible was given to teach science itself - and that therefore there is but one revelation, that of God's word, and no separate and previous revelation of his works at all.[113]

The third argument emphasised the educational importance of natural theology. The Combeists protested that concentration on the Book of Nature as well as, or even instead of, the Book of Revelation did not tend to irreligion. As the Scotsman insisted after criticisms of Simpson's proposals for secular education:

> Instead of excluding religion from education, he yields to none in anxiety that it shall form a much more efficient branch of education than it has ever yet done.[114]

The point was developed in a lecture by William Hodgson. Hodgson contended that the secular and the religious were in fact inseparably connected. Science, studying and interpreting the laws of nature, was the exposition of the character of the Creator, the author of these laws. This was true whether the laws related to the earth, the heavens, the world's history or the fundamental workings of society:

> Nay, to deny the religious aspect of these studies - what is it but to shut out the Deity from the Universe which he has made?[115]

Hodgson thus turned accusations of infidelity back against the accusers, a popular strategy with the Combeists.

The fourth prong of the assault was the one which went furthest in attempting to undermine the authority of the Church. In claiming that the revelation of God's will through his works might be preferable to interpretations of Scripture, the phrenologists could

challenge not only the curriculum of weekday education but also the content of the Sunday sermon. Christian doctrine itself would have to be modified in the light of the discoveries of physical science and of phrenology, the true science of human nature. Combe and his colleagues were careful about challenging directly the authority of the Bible, frequently claiming that it was the standards of the Scottish Church, rather than the Scriptures themselves, which were in need of revision. Nevertheless their contention was that the Book of Nature yielded far more reliable knowledge than could be obtained from Holy Writ, and that where the two were in conflict it was the interpretation of Scripture which must be altered. As Combe remarked in a letter to an English clergyman, the Rev. Robert Broadley:

> Either the Scottish standards are erroneous interpretations of Scripture, and need to be corrected, or I am in error in my views in regard to the brain; and no greater service could be done to the causes both of religion and philosophy than to publish a work shewing where the error lies.[116]

With the argument expressed in this way, the Combeists ran the greatest risk of inviting charges of infidelity. More commonly, they presented the argument in a slightly weaker form, emphasising the need to precede doctrinal instruction with a good grounding in the 'religion of nature'. Phrenologists held very strong views about the correct age at which a child should be introduced to each stage of his/her education. Ir was therefore possible to couch their aversion to doctrinal religious instruction in terms of an overall theory of mental development. Theological dogmas were not only less soundly-based than the Book of Nature, they were less suitable for growing minds (or brains). As William Hodgson declared:

> Why should the young, before the power of judgement is developed, be perplexed with doctrinal difficulties and

> disputes, with contending arguments, authorities, and probabilities?[117]

A similar point could be made in relation to the education of adults. Doctrinal preaching was indigestible fare for the uneducated mind, and therefore ineffective in bringing about any moral improvement in the recipients. The secularists' use of the word "moral" was not co-extensive with its use by clergymen since it included matters of hygiene and diet as well as the more traditional concerns of moralists. However, the clergy were held to be failing even in their own terms. According to Simpson:

> A weekly discourse is as the passing wind on the ears of the habitually greedy, the envious, the sensual, the tyrannical, the revengeful, the utterly selfish, a stated preceptive lesson to love God, and his neighbour as himself is unheeded by the man whose whole soul is drawn by a power, which he was never taught practically to resist, in the opposite direction.[118]

Still less were they succeeding when their efforts were weighed on the scales favoured by the Combeists, who were fond of collecting evidence of the most degraded and dirty living conditions mingled with the pure waters of Calvinist orthodoxy. The Scotman explained:

> We are not deriding theological education, but only insisting that something is needed besides. Those portions of our population most zealously instructed in theology, and most exclusively under clerical influence, are not our best citizens - we do not say, because they have too much theology, but because they have little or nothing else. We might point to Ireland, where theological teaching is abundant, and clerical influence supreme - but we should be told that that religion is false, degrading, and so forth. Well, then, take our own Presbyterian, Free Kirk Highlanders. Among that people 'the minister' is a monarch, and you will find in the wildest glens of Ross and the dreariest bogs of Skye multitudes not only "deep in divinity" but capable of telling you all about non intrusion, the Marnoch case, and the Erastian Court of Session; and yet all the world knows how these same multitudes stand affected in such matters as sloth, dirt, and deceit.[119]

The Presbyterian Dissenters' desire for a national scheme of

non-denominational education was probably the main reason that Combe received support from secession ministers in 1836. As Voluntaries, the Dissenters believed that the State and religion should be entirely separate. As they had defended Combe's Constitution of Man, so also Simpson's Necessity of Popular Education. Although it expressed a few doubts about Simpson's orthodoxy, especially on the doctrine of Original Sin, the United Secession Magazine was pleased to find "a sort of religious air", pervading the work. The Scriptures were always spoken of with reverence and even the doctrine of Free Grace was mentioned with approval.[120] By contrast, the Scottish Guardian denounced Simpson's views as "pernicious". The Evangelical newspaper condemned the Voluntaries for joining with "Papists" and "political liberals" in establishing a system

> ... which shall exclude the Word of God or embrace such portions of it only as shall give no offence to any of the heterogenous components of this three-fold union - thus, in either case, undermining the paramount authority of the principle, that "the fear of the Lord is the beginning of knowledge".[121]

Besides engaging in political campaigning, the Combeists attempted to put their educational ideas directly into practice. At their request Samuel Wilderspin, a pioneer of infant education in the Spitalfields area of London, visited Edinburgh in 1828.[122] James Simpson was a member of the committee which was established shortly afterwards to set up the Edinburgh Model Infant School. Infant education catered for children from about the ages of 2 to 6. Some of Wilderspin's inspiration undoubtedly came from Robert Owen's experiments at New Lanark and from other educational innovators such as Pestalozzi.[123] Phrenological theory and language also pervaded his educational writing. He stressed that education should develop

the whole person, not just the child's intellectual nature, and put great emphasis on educating by things rather than by signs. The chief aim of Wilderspin's system was the child's moral development. The infant teacher was to maintain constant and close supervision of pupils' behaviour, directing them in conversation and encouraging them to be polite and kind. Wilderspin used moral lessons from the Bible, but instead of employing the original text, he allowed the teacher to convey the sense of the parables using his own words and coloured pictures. There were no canings and no other punishments which attributed shame or disgrace to a pupil. He saw infant education as a means of rescuing poor children from an early drift into crime and misery.[124]

The committee running the Edinburgh school drew members from a wide cross-section of religious opinion, including several ministers of the Established Church. In Glasgow, infant education developed along different lines. Wilderspin was invited to lecture by David Stow, an evangelical and an elder of Chalmers' Church.[125] Stow subsequently founded schools of his own in Glasgow and wrote a number of books about the moral training of the young, in which Wilderspin's influence was apparent. Stow contended that in the past children had been educated "not agreeably to nature", and he felt that it was important to distinguish "training" - the establishment of moral and religious habits - from mere "teaching", which operated on the intellect only.[126] The tone of his work, like Wilderspin's, was optimistic, displaying confidence in the power of education, provided early enough, to counteract the effects of a poor home environment.

Like Wilderspin, Stow disapproved of rote learning. Rather than making pupils commit large portions of Scripture to memory, he felt

that it was essential they understood what they were reading. Instruction in the Book of Nature enhanced appreciation of the Book of Revelation:

> What human science is there, the outline of which must not at least be entered upon, ere we can have a full understanding of Bible illustrations?[127]

Such views commended Stow's works to the Combeists and even as late as 1847 a sympathetic note was sounded by a reviewer in the Scotsman:

> This decisive testimony to the inefficacy of mere Catechism and Bible lessons, when taught by rote to produce virtuous habits, is doubly valuable, coming as it does from a highly Evangelical quarter.[128]

Stow however, drew back from the inferences made by Combe's circle, and quickly it became clear that, as in the case of elementary schools, no consensus could be achieved over the role of the Bible in infant teaching. Stow considered Wilderspin's list of Bible lessons to be defective and ensured that the Glasgow schools administered a far stronger measure of the Gospel. Indeed he offended the phrenologists still more by using the Scriptures in secular learning too. In the London Courier, a director of the Edinburgh Infant School Society complained that the Glasgow schools were under "sectarian management". As a supporter of the Wilderspin system, he deplored "the excess of Scripture exercise imposed by these excellent but over zealous managers".[129]

Stow in reply dispelled any impression that he might previously have given of subscribing to phrenologists' arguments about the priority of the Book of Nature:

> ... we know enough of the imperfection of mere natural religion, to know that the Works of God cannot be rightly interpreted but by a mind that is first enriched and imbued with the knowledge of God through the only clear and full revelation of Himself in His Word.

According to Stow, the Edinburgh schools taught "only so much of Christianity as is common to natural religion, and would be agreeable to an Infidel".[130] Shortly before this, the broad basis of the Edinburgh infant schools had also begun to disintegrate. Around 1835, two ministers left the Society for Promoting Infant Education to found schools of their own, modelled more closely on Stow's principles.

Another initiative a few years later for the education of poor children began on a non-sectarian basis but controversy again broke out over the place of the Bible. The schools of industry or ragged schools were intended for the very poorest children, who lived by begging and stealing, and who were frequently committed to prison before the age of fourteen. In 1841, a small sum of money was raised in Aberdeen in order to found a school in which such children could work and receive free instruction and simple meals.[131] Ragged schools were later established in Dundee, Glasgow and Edinburgh. In Edinburgh, the Free Church minister, Thomas Guthrie, took up the idea and in 1847 published his Plea for Ragged Schools, in which he drew attention to the appalling conditions of children in the Grassmarket and Vennel areas of the city. The parents of such children would not send their children to ordinary schools even if instruction were offered free, since by being at school the child was prevented from "earning" his living. Following the Aberdeen example, Guthrie emphasised that the necessary incentive could be given by providing the pupils at his schools with food. This also ensured that the children were in a fit state to be taught, for "what heart has he for learning, whose pale face and hollow eyes tell you that he is starving?"[132] Guthrie considered that this combination of material

with moral remedy reconciled the stern social gospel of Thomas Chalmers with the views of the poor law reformer, William Alison:

> With Dr Chalmers we have always thought that it was through moral and Christian machinery that our degraded and deep-sunk population were to be raised; for their permanent good we had no faith in any other scheme. With Dr Alison, again, we always thought that the maintenance of the poor was miserably inadequate to their wants, and that this stood as a barrier between them and the moral influences by which Dr Chalmers would ameliorate and permanently improve their character. We agreed with both, and confess that we could never very well see how they seemed to disagree with each other.[133]

The Scotsman praised Guthrie's pamphlet,[134] echoing the enthusiasm of Chambers' Journal for the Dundee and Aberdeen schools,[135] and a preliminary meeting in April 1847 attracted a cross-section of supporters including Lord Murray (a Court of Session judge), James Simpson, and the Rev. Thomas M'Crie of the Original Secession Church. The result was the formation of an association "on a broad and catholic basis".[136] It was only a short time, however, before the supporters of ragged schools quarrelled over the position of Roman Catholic children. Simpson and other liberals alleged that the Edinburgh school de facto excluded these children by insisting on teaching from the authorised version of the Bible. At a public meeting called to discuss the issue, Simpson denied wanting to exclude the Bible from the industrial schools, and asked only that Catholic children should be taught by their own pastors from their own Bible. Nevertheless, the opposing side clearly felt that the retention of the Scriptures was at stake. Guthrie spoke of a "Bible battle" and another speaker felt that the question was "whether children shall be religiously educated or not, and whether that religious education shall be conducted according to the Word of God or not".[137] The meeting ended by adopting overwhelmingly a motion warmly approving

the principle upon which the ragged school was conducted "namely, the free and unrestricted use of the authorised version of the Word of God".[138] The implication was that the Roman Catholics must set up schools of their own if they disliked Guthrie's.

Akthough their attempts to enter university education were somewhat half-hearted, the Combeists were determined in their efforts to extend popular forms of adult education, especially if these were to be channels for disseminating their own philosophy. Edinburgh in the early nineteenth century was a 'metropolis of science', in which the professional lecturer found himself part of a thriving industry. Many smaller towns in Scotland also had their own literary and philosophical societies and mechanics' institutes, offering instruction in a wide range of subjects from music to political economy.[139] Indeed, the mechanics' institutes may have been a Scottish invention since one of the first was established in Methven, Perthshire, by the scientific writer Thomas Dick.[140]

In 1821, the Edinburgh School of Arts was founded by the Whig lawyer, Leonard Horner, to provide technical training for members of the artisan class.[141] A large number of similar organisations were established shortly afterwards throughout Great Britain with the encouragement and support of Henry Brougham's Society for the Diffusion of Useful Knowledge. Maxine Berg has suggested that one of the principal aims of Brougham's mechanics' institutes was to persuade the manual labouring class of the benefits of increasing industrialisation. The object was to foster the belief that the advance of technology and its application to manufacturing would bring advantages both to the capitalists and to the workers.[142] Such an objective would certainly have been feasible in cases where, as

with the Edinburgh School of Arts, the institution was under the control of a social elite. However, this was not always the case. Some institutes were formed by groups of workmen banding together for mutual improvement, such as the mutual instruction societies established in Aberdeenshire in the early nineteenth century. Even when there was a degree of involvement by social superiors, control might be in the hands of the members. Dr George Birkbeck established the mechanics' class in Anderson's Institution, Glasgow in 1800 and in 1823 this was transformed into the Glasgow Mechanics' Institution. The Institution was democratically run, lecturers being chosen by the full body of members.[143] There was thus considerable diversity among the mechanics' institutes in the way they were organised and in the subjects taught.

The Combeists were euphoric about the general increase in popular instruction, which they hailed as a sign that a more rational and enlightened age was dawning. Occasionally, their enthusiasm on this point sounded somewhat at odds with Simpson's gloomy assessment of the current condition of the labouring population:

> In the intellectual world there is at this moment a great movement. The moral lines of demarcation which so invidiously separated one class of the community from another in that world, are fast disappearing. Breaches are everywhere being made in the fences which learning had raised around knowledge, and the crowd is pouring in at all hands, and dispersing themselves over the tabooed ground which they inclosed.[144]

The phrenologists' main criticism of the mechanics' institutes concerned the curricula. They regretted the exclusion of non-vocational subjects, such as physiology and political economy. The Edinburgh Weekly Chronicle warned that if these subjects were not offered by the School of Arts, the working classes would be obliged

to learn them elsewhere.[145]

The Combeists attempted to make up for these curricular deficiences by founding societies of their own for popular instruction, though these were not always devoted exclusively to propagating the philosophy of Combe. The Edinburgh Philosophical Association, an organisation of shopkeepers and merchants, proved to be more independent than Combe and his colleagues would have liked. Founded as the Association for Providing Instruction in Useful and Entertaining Science, the Society had a strong link with Combe's circle in its early years. It grew out of Combe's lectures in the Clyde Street Hall in the summer of 1832, and in successive seasons heard from him on popular education (winter 1833-4), again on phrenology (winter 1834-5) and on moral philosophy (1835-6). Other lectures covered natural philosophy, botany, astronomy and "the laws of animal economy".[146] As Shapin has shown, the directors subsequently quarrelled with Combe over a scheme to provide popular lectures in other Scottish towns. After 1835 the Association's links with Combeism were more tenuous.[147]

The phrenological secularists also catered for the educational needs of the manual labouring class. In 1835, the Society for Diffusing Moral and Economical Knowledge was formed in Edinburgh to provide instruction in subjects not offered by the School of Arts to thse who could not afford to attend the Philosophical Association. The lectures, delivered in the Cowgate Chapel, cost 1d a time. In 1835-36, Simpson gave a course of lectures to the Society on mind and morals and William Hutcheson, a surgeon, dealt with the structure and functions of the human body.[148] There seems to have been a strong Combeist influence on this Society. It is evident from

correspondence that Nichol and Combe took a keen interest in its activities.[149] In 1837, it apparently changed its name to the Association of the Working Classes for their Intellectual, Moral and Social Improvement. William Hodgson lectured to the Association on phrenology, and lectures were also offered on political economy and chemistry.[150] The Society apparently ceased to exist after 1837.

What kind of moral and philosophical teaching did the Combeists provide? As I have already underlined, their natural theology stressed the completeness of nature as a guide to human conduct. Natural laws were also immutable and universal. Combe thus poured scorn on the possibility that wrongdoers would be punished by direct Providential interference, discounting the belief as a clerical superstition, and emphasising the separate operation of the physical, organic and moral laws:

> A ship, therefore, will float on the surface of the water as long as these physical conditions are observed; no matter although the men in it should infringe other natural laws; as, for example, although they should rob, murder, blaspheme, and commit every species of debauchery; and it will sink whenever the physical conditions are subverted, however strictly the crew and passengers may obey the other laws here adverted to.

On the other hand, a man who cheated, lied, stole and tyrannised might remain "fat and rubicund" so long as he observed the organic laws of temperance and exercise.[151]

It was these organic laws which were the Combeists' chief preoccupation. All forms of behaviour were ultimately related to their effect on man's physical well-being. The organic laws of health were the paradigmatic natural laws, and, despite Combe's claim that the moral laws were superior to the organic, in practice the organic tended to take precedence. The Constitution of Man was

replete with warnings about the suffering which would be visited upon those who slept in unventilated rooms, repeatedly worked themselves beyond tolerable limits, or took sudden, violent and unaccustomed exercise. Moreover, when he offered concrete examples of how disobedience to a natural law led to punishment, Combe typically chose an organic law rather than a moral one. An instance of this occurred even in the section of the Constitution of Man purportedly dealing with the moral laws: a businessman who failed to take adequate rest and relaxation was described as suffering from headaches and indigestion and this was offered as an exemplar of just punishment arising from neglect of a divine law.[152] By 1840, in Moral Philosophy, he was describing the preservation of bodily health as itself a "moral duty", and habitually referring to violations of any of the natural laws in moral terms:

> When the object of human existence is regarded in this light, it becomes evident that obedience to every natural law is a positive duty imposed on us by the Creator, and that infringement or neglect of it is a sin or transgression against His will.[153]

Simpson's Lectures to the Working Classes had a similar emphasis, warning against the abuse of alcohol, drawing attention to the evils of tobacco, and stressing the physical as well as the economic penalties of early marriage. Physiology was thus enlisted in order to reinforce the teachings of Malthus:

> Early marriages are gross immoralities. Physically, they produced a stinted, inferior, and often idiotic offspring. Economically, they are almost always ruinous to the prospects in life. A reckless people sunk in poverty are marked for their early marriages.[154]

Indeed, the advice of the physiologist and the doctor could take precedence over economic pressures. Simpson enjoined mothers to stay at home to look after their children, rather than going out to work.

Andrew Combe similarly stressed the importance of a good home environment in determining the child's mental development.[155]

Traditional moral prohibitions on dishonesty, lust and greed were less easily supported by 'natural' sanctions. Combe wrote of the "mental joy" which followed obedience to the moral laws, but penalties for disobedience were less easy to identify.[156] Other sanctions suggested by Combe were the torment of "insatiable desires", the "perpetual craving" of the moral sentiments for "higher emjoyments" and the "dislike and malevolence" of one's fellow men.[157] Alternatively, the Combeists could fall back on their theory of heredity, which acted both as theodicy and source of sanctions. The offspring of the virtuous would inherit superior mental constitutions, the children of the vicious would have inferior mental constitutions.

In fact, the Combeists did at times fall back on a modified version of the clergy's punitive interpretation of disease and disaster. Combe and his colleagues considered these to be indirect penalties for disobeying moral laws. The Scotsman noted that the clergy regarded disease epidemics as judgements but "not quite in the practical sense, in which experience shows that they should be understood."[158] For the Combeists, God punished not by supernatural intervention but in the preordained consequences of disobeying His laws. Combe stressed that the physical and organic laws were constituted "in harmony with, and in subserviency to, the moral law", and, unless the moral laws were obeyed, all kinds of organic and physical laws would be disregarded.[159]

As a writer in the Phrenological Journal admitted, although it was theoretically possible for a man to obey the physical whilst

violating the moral law, in practice immoral men would break many physical laws too:

> We have said, that if a reckless contemner of religion were sober and temperate in his habits, and possessed a good constitution, his broken leg would heal as kindly as that of the most pious Christian, if both were subjected to the same surgical treatment; but this is very nearly an impossible supposition. The character of a contemner of religion implies preponderating animal with deficient moral and intellectual organs, and the natural tendency of this combination would be to impel him to sensual indulgences and reckless conduct, which would impair the tone of his bodily organs, impede their functions, and create nervous irritability; so that when his leg was broken, the accident would fall upon a system physically deranged. His impatient temper, or, in other words, the activity of his organs of Combativeness and Destructiveness, would be unfavourable to repose, and that from these natural causes, without any special act of Divine Providence, his chances of a speedy recovery would naturally be diminished. The piety of the other individual would naturally induce in him a habit of body and a temper of mind the opposite of that which has now been described, and if their constitutions were originally equal, the injury equal, and the surgical treatment the same, the morality of the one would cast the balance in his favour, while the immorality of the other would turn it against him.[160]

Thus, despite Combe's insistence on the separate operation of the physical, organic and moral laws in his attempts to discredit the clergy's moralised interpretation of disease and disaster, the Combeists were on occasions quite happy to mix the laws up again to make up for any deficiency of direct moral sanctions in their own system. Physical and moral well-being became synonymous, both for the individual and for society as a whole. Combe justified the teaching of physiology in schools not only because it would lead to improved sanitary conditions and lower mortality rates but also because of the service it rendered to the explanation of "Social Economy". A catechism used by Combe for teaching school children led them from consideration of their need for meals at regular intervals to reflection on how the food was produced and the divinely-ordained

duties fulfilled by the farmer and the baker. This in turn led to questions about the interdependence of the farmer, the tradesman, the schoolmaster and the clergyman, and about the desirability of hard work, honesty and conscientiousness:

> If God has established all this in the framework of our bodies and the endowment of our minds, is he a clever fellow who tries to find a shorter way than by skilful and honest labour, to a supply of bread, who, for example, cheats to get, or steals it? "No, Sir", Q. Can bread be produced by cheating and stealing? (A laugh). "No, it cannot" - Q. Do the men who try to get bread by these means, take it from some one who has produced it, or has obtained it by giving something valuable in exchange for it? "Yes". - Q. Then is it the interest of all good, skilful, and honest people to stop these men from eating the bread which they do nothing to produce? "Yes".[161]

The physical, the organic and the moral were links in the same chain leading to their divine author.

The Combeists' emphasis on bodily health appalled their clerical opponents, who denied that there was anything moral about sleeping with open windows or choosing nutritious food. Indeed it was often morally correct to set these laws aside in the interest of some higher moral purpose:

> Now, it is only the moral laws that imperatively regulate our conduct. Obedience to the first two classes is only prudential, and often has nothing moral in it. Moral laws should be obeyed at all times, and in all circumstances.[162]

One form of undesirable behaviour, whether viewed from a physiological or from a moral point of view, was drunkenness. It was condemned with equal fervour by the Combeists and the Evangelicals, although there does not seem to have been any co-operation between the two sides in the temperance societies which sprang up from the late 1840s onwards. This was despite the tendency noticed by Brian Harrison for secularists to try to outdo their clerical counterparts in abstemiousness.[163] While the Free Church became deeply involved

in the temperance movement, the secularists preferred to warn of the evils of alcohol as part of a more general curriculum of moral education. In the Philosophy of Education, Simpson gave general approval to the aims of temperance societies but was doubtful about their chances of success. He regarded alcoholism as a disease which ranked the sufferer "among the insane" and thought that the societies failed to appreciate the relationship between mind and body.[164]

The area of moral teaching in which the Evangelicals and the phrenologists came closest to agreement was the economic discipline of the labouring classes. It is interesting to notice that both parties considered political economy to be a science with a strong moral dimension. William Hodgson was at pains to defend the subject against the charge that it offered a narrow and essentially selfish picture of human character. Economic behaviour was to be understood in terms of moral and mental laws, and misbehaviour was subject to society's judgement in just the same way as more traditional forms of wrong doing:

> Not only the profligate, the gambler, the swindler, and the drunkard, but the idle, the reckless, the unpunctual, the procrastinating, find here a bitter but wholesome condemnation;[165]

In the Christian and Civic Economy of Large Towns (1826), Chalmers admitted that it was not essential to teach political economy in order to instil discipline and order into working class life. Any instruction would have a civilising effect on the taught:

> It is enough that they [lectures in mechanics' institutes] call forth the aspirations of that higher nature, which has so long been overborne by the urgency of their animal wants, and the unchastened violence of their mere animal propensities.[166]

The similarity to phrenological language is striking. Surprisingly,

too, Chalmers did not insist on explicitly religious instruction in order to exert a civilising influence. He noted that, in visiting the home of a labourer, a bookshelf well stocked either with religious or with scientific books usually indicated a taste for material comforts and a well-ordered family life. Although not a requirement, political economy was nevertheless a desirable addition to the curriculum of mechanics' institutes. Chalmers regretted that it had not been taught for fear that it would encourage political unrest:

> ... we despair not of the day when the science of political economy, instead of being dreaded as the instrument of a dangerous excitation, will be found, like all other truth, to be of powerful efficiency in stilling the violence of the people.[167]

We saw in chapter four that Chalmers was a highly conservative thinker. Despite his zeal for changes in educational institutions and for the more effective exercise of popular rights in the Church, he was implacably opposed to fundamental changes in the structure of society. The Combeists, by contrast, were moderate radicals, opposed to aristocratic privilege and anticipating the remodelling of society on rational, scientific principles. In discussing the social system, Combe's use of nature was different from Chalmers'. Where Chalmers had set man apart from nature, Combe reintegrated him. Society, as at present constituted, had defects precisely because of man's defects:

> ... the lives of the inhabitants of Britain generally are devoted to the acquisition of wealth, of power and distinction, or of animal pleasure; in other words, the great object of the labouring classes, is to live and gratify the inferior propensities; of the mercantile and manufacturing population, to gratify Acquisitiveness and Self-esteem; of the more intelligent class of gentlemen, to gratify Self-esteem and Love of Approbation, in political, literary, or philosophical eminence; and of another

> portion, to gratify Love of Approbation, by supremacy in fashion; and these gratifications are sought by means not in accordance with the dictates of the higher sentiments but by the joint aid of the intellect and propensities.[168]

It was not only the labouring classes who had to change. They were overworked as a result of the acquisitiveness of their employers. The economic consequences were overproduction, low prices and unemployment. The human consequence was a class obliged to work for ten, twelve or fourteen hours a day, a class which had neither time nor energy for moral and intellectual pursuits. This led in turn to "the excessive craving for the stimulus of ardent spirits which distinguishes the labouring population of the present age".[169]

Combe was no Chartist. The Combeists favoured only a gradual extension of the franchise, dependent on the provision of improved education for the new voters. Combe's view of political change was that "no nation can become fit for a republican form of government until all classes of the people have been adequately and nearly equally instructed."[170] All social and political progress must be slow, in accordance with the phrenological theory of mental development. The differences between the aspirations of Robert Owen and those of the phrenologists were succinctly expressed by Combe in a letter to J.P. Nichol:

> We had a visit from Robert Owen who talked precisely as he talked 42 years ago. He is to regenerate the world in three months: I said that the Phrenologists required three centuries. This is the widest difference between us.[171]

Phrenology could therefore serve as a counterweight to the radical aims of the Chartists and the Owenites. The conservative face of phrenology emerges, not surprisingly, when we examine the teaching the Combeists directed at the labouring classes.

Combe like Chalmers, put forward a version of the Malthusian law

of population. Characteristically, he translated the moral restraint of Chalmers and Malthus into phrenological language, admitting that its exercise might be attended by suffering to those whose organs of amativeness (the faculty of sexual attraction) and philoprogenitiveness (the faculty associated with the love of one's offspring) were very large. However, to restrain the activity of the propensities by the exercise of the moral sentiments and intellect was sound phrenological teaching. In a letter of 1836, Combe remarked that he knew many individuals who found no hardship in postponing gratification of these propensities until the age of 25 or 30. As for those with weaker mental constitutions, Combe, like Chalmers, fell back on the power of education. Combe, however, based his belief in gradual improvement on a biological, hereditarian foundation:

> I believe that a sound and efficient moral and intellectual education, with an enlarged enjoyment presented to the superior faculties, would greatly abate the vivacity of the lower feelings and ultimately lead to a diminution of the size of their organs in the race.[172]

The Scotsman wanted the law of Malthus to be "sounded in the ear of every labouring man in the country".[173] The message was clear: unless the individual helped himself, he could expect no improvement in his lot.

The desire to contain a threat of potential unrest amongst the labouring classes explains the more conservative pronouncements made by the Combeists. For instance Combe, in an address given in 1848 and reported in the Scotsman, invoked the supposedly divinely-ordained arrangements of society in order to justify the existing class structure. The middle classes were held up as an example to the working classes:

> He did not believe that God Almighty acted as a partial payer. He thought He did equal justice to all, and was of opinion that the difference lay in the difference which they themselves made. He ascribed the success of the middle classes to the extraordinary amount of cultivation which they bestowed on the minds of their children, which produced a mental capacity to deal with this world's causation.[174]

Similarly, in parts of the Constitution of Man, he conjectured that there was much to be said for the apparent deficiencies in some mental constitutions, anxious that they should not be made the grounds of an objection to the unqualified benevolence of their Creator:

> ... there may, by possibility, be departments in the great system of human society, exactly suited to all existing forms of brain, not imperfecct through disease, if our knowledge were sufficient to discover them.[175]

That Combe was no violent radical is demonstrated by the reaction to his teachings in Whig circles. Although the Edinburgh Review had ridiculed the scientific pretensions of phrenology, Combe's social philosophy met with a more benign reaction.[176] As Henry Cockburn, the lawyer and chronicler of the Edinburgh social and political scene, confided in his Journal:

> This George Combe, the patron and expounder of Edinburgh phrenology, is a calm, excellent man, with a clear natural style of didactic speaking and very benevolent objects. Some wise people call him a quack, of which his phrenological pretensions are their proof; but I am satisfied that he really believes in that folly, as many other honest men do.[177]

Similarly, the contention of an article on 'Phrenological Ethics' in the Edinburgh Review (1842) was that a great deal of the phrenologists' moral philosophy owed nothing to phrenology at all. Much of it had been known and acepted long before the publication of the Constitution of Man.[178]

In the 1830s, the Evangelicals, like the Combeists, expressed

high hopes of the benefits to be derived from mechanics' institutes. Besides making the mechanic better at his job, the Evangelicals believed that the institute kept him away from the public house or the socialist meeting. The Scottish Guardian recommended the lectures at the Glasgow Mechanics' Institution as capable of undermining "amusements and indulgences still two [sic] prevalent amongst the working classes, and which cost them far more money than a season ticket for the Mechanics' Institution, and produce infinitely less profit and satisfaction."[179] The Glasgow Institution's inclusion of lectures on phrenology apparently did not dampen the Guardian's enthusiasm.[180] The institutes were also beneficial in fostering contact between the working classes and those of a higher social rank. However, there were also signs of concern that mechanics' institutes might fall under the wrong influences. As early as 1833, the Scottish Guardian was urging ministers and laymen to

> ... take an interest in these seminaries of the working classes - for to neglect them will be just to repeat the blunder which has already been committed in neglecting so long the periodical press.[181]

Evangelical writers also began to detect faults in some of the popular scientific periodicals and books of the day, either in what they included or in what they left out (or both). Thus a reviewer of the Moral Class Book, produced by Messrs. Chambers, complained that it contained too little Christianity and was "silent on the means of man's salvation, and on the divinity of its Agent".[182] The prospectus of the Scottish Christian Herald (1836) sounded a note of urgency:

> All sorts of Literary Machinery, - Newspapers, Lectures, Treatises, Magazines, Pamphlets, School-Books, Libraries of

> Knowledge, for use or for Entertainment, - are most diligently and assiduously set in motion, if not for purposes directly hostile to the Gospel, at least on the theory that men may be made good and happy without the Gospel:- nay, though the Gospel were forgotten as an old wives' fable.[183]

There are also indications that divines occasionally launched indiscriminate attacks on organisations which were considered to be spreading dangerous and irreligious doctrines. Combe referred in a letter of 1835 to a tirade by Dr Muir, minister of St. Stephen's Church, Edinburgh, against Simpson "including also the Philosophical Association & my lectures".[184] William Hutcheson was probably referring to clerical hostility when, replying to a presentation at the close of his series of lectures to the Society for Diffusing Moral and Economical Knowledge, he complained of "virulent abuse" against both Simpson and himself by "those interested in the perpetuation of darkness".[185]

Usually the Evangelicals were careful to distinguish the medium of instruction from the message. This was true both in the case of the evening lecture and of the periodical press. Combeism, in particular, rather than useful knowledge in general, was invariably the target for their attacks. Indeed, Evangelical intellectuals were sensitive to accusations of being anti-scientific. In its review of Combe's Constitution of Man, the Edinburgh Christian Instructor (1836) remarked:

> We cannot, however, plead guilty to the charge of being suspicious of the progress of science, or hostile to the study of nature, or to the acquisition of knowledge of whatever kind. On the contrary, we have always felt, and have often expressed the sentiment which we uttered so recently as last month, when we said, "The volumes of nature and of inspiration are written in very different characters; but they are written by the same author; and we may rest assured that the conclusions which are correctly drawn from the one, will always corroborate the

announcements made by the other".[186]

The Scottish Guardian reported with evident pleasure the disagreement between Combe and the Directors of the Edinburgh Philosophical Association and the hissing which, according to the Guardian, greeted some of Combe's lectures to the Association in the winter of 1835-6.[187] The Philosophical Association seems to have broken away entirely from its original roots in 1846 when it metamorphosed into the Philosophical Institution. Equipped with a prestigious list of extraordinary directors, its managers proclaimed their intention of providing instruction for all classes "from the clerk to the commercial and professional man".[188] Thomas Chalmers and Robert Chambers were among those who expressed their enthusiastic support, and further evidence of its non-sectarian character is contained in a letter from William Hodgson to one of the managers of the Institution, written in 1857:

> Tulloch, Morell, Hanna, Nichol, Rogers, and Dean Ramsay all appearing in one session give noble evidence of the true liberality and justice of your committee in giving a hearing to all parties, within no other limits than the self imposed bounds of courtesy and discretion.[189]

Brewster and Miller also lectured at the Institution during its first decade.[190]

Those who ran organisations providing adult education clearly had difficult decisions to make about who should be invited to lecture. Choices sometimes had to be made between subjects which were popular but which might antagonise religious opinion and less overtly ideological ones which might attract smaller audiences. In the case of the Edinburgh Philosophical Association, the managers evidently decided that in the interests of long-term survival it was best to make it as broadly-based as possible. The experiment seems

to have worked, since the Institution survived into the twentieth century.[191]

An alternative to participating in broadly-based organisations was for the Evanglicals to found societies of their own with specific doctrinal aims. In 1836, a society called the Institution of Science and Literature was established in Edinburgh

> ... for the purpose of promoting public instruction by mingling the educated and the working classes together, and, at the same time, seeking improvement through other means than the doctrines and theories prescribed for public study by many popular societies of the present day, having in particular, as expressed in their constitution, "no confidence in the doctrines of Phrenology".

Its exact religious affiliation is not clear but a reference in its advertisements to "the fatal, material and unscriptural views of Phrenology and Phrenologists" suggests an Evangelical connection.[192]

The Institution seems to have fallen apart quite quickly but a more concerted attempt to combat Combeist and other heresies was made in the late 1840s, by an organisation called the Scottish Association for Opposing Prevalent Errors. Founded in 1845 and open to all those holding "sentiments usually known under the name of Evangelical", its objectives were to combat not only the teachings of the Constitution of Man and Vestiges of the Natural History of Creation, but also Popery and socialism.[193] At its first public meeting, Andrew Thomson, a United Presbyterian minister, emphasised the need to call upon

> ... the mightiest minds of our age, those on whose honoured heads we see at once the crown of Science and the crown of Christianity - our Brewsters, our Bucklands, and our Sedgewicks [sic], to meet such men as George Combe, and the covert author of the Vestiges of Creation, and to repel scientific cavil with scientific reply.[194]

A striking development by this time was the change of mood in the

Dissenting churches towards the teachings of the Combeist school. Interestingly, most of the Association's clerical office bearers appear to have been from these churches. In 1846, the Association brought out another refutation of the Constitution, written by the Rev. C.J. Kennedy of Paisley.

Kennedy's Nature and Revelation Harmonious followed Scott in trying to show the inconsistency between the science of phrenology and the secularism of many phrenologists. The author claimed that both geology and history contradicted the doctrine of natural and inevitable progress. Like Scott, he also detected in Combe's own admission of the dominance of the lower faculties, a phrenological version of the Fall:

> Thus the animal part of man takes the lead, and acting powerfully, without the aid of culture or previous exercise, overpowers the rational faculties; and, bringing them into unnatural subjection, occasions the existence of gross sin and great misery. This superior promptitude and activity of man's animal faculties is an inborn defect in his constitution; it is tantamount to an inherent original tendency to sin.[195]

He also took Combe to task over the alleged invariability of the natural laws. Kennedy admitted that alterations to their operation were rare but argued that proof existed for the efficacy of prayer. Against Combe, Kennedy also contended that human improvement could be brought about by supernatural influence. Religion could be brought even to barbarous tribes, whose mental constitutions allegedly made them unfit for religious influence. Once again, there was a round of refutation and counter-refutation, although more amicable than the earlier exchanges with Scott. Kennedy admitted to his adversary that he was

> ... cordially disposed to give you full credit for all the

> important truth which your work on the Constitution of Man contains ... and anxious only to counteract certain dangerous views which it appears to countenance.[196]

Such a friendly interaction was unusual. In correspondence with one another, members of Combe's circle delighted in referring (no doubt ironically) to their own teachings as "blasphemy" and "heresy".[197] The 1848 Report of the Association for Opposing Prevalent Errors granted the Constitution of Man the distinction of having produced "more of the infidelity that exists among the middle classes in England and Scotland at the present day than any other book which could be named."[198] On the lower orders too, Combe was held to have exerted a baneful influence. In an article on unbelief amongst the working classes, the Free Church Magazine blamed such works as Combe's for producing most of the "speculative infidelity of the day".[199]

In 1846, the United Secession Magazine attacked the Constitution of Man's "insidious and destructive philosophy" which it feared had disseminated "the seeds of antiscriptural opinions" on a large scale.[200] In 1848, hinting that there had been some change of heart amongst the secession churches, the Rev. John Law of the United Presbyterian Church regretted that "not a few of our ministers have been the means of introducing them [Combe's writings] into their congregational libraries".[201] By 1853, the United Presbyterian Magazine was claiming that "the Naturalism of Combe and the "Vestiges" is but a half-way station to the Atheism of Holyoake".[202] Particularly galling for the Free Church was its own lack of success in attracting members of the labouring classes. In Aberdeen, for instance, MacLaren concludes that, despite strenuous efforts in destitute areas, including the setting up of preaching stations

operated by the Free Church City Mission, the Church never overcame its losses as far as working class members were concerned. Working class worshippers were repelled by "the middle class nature of the new Church and its inquisitorial financial organisation, coinciding as it did with a period of grave economic recession in the city".[203] Although Chartism in Scotland had made little impact, there was a continuing fear of social disorder amongst the working classes. The Evangelicals tended to view the Constitution of Man as the door to every other form of heresy, from socialism to pantheism.[204]

I now consider what positions were taken up by Brewster, Chalmers, Fleming and Miller in the debates about phrenology. During the 1820s, Combe seems to have been on friendly terms with Chalmers. Shortly after the founding of the Phrenological Society, Chalmers called on Combe to see Combe's collection of casts (used in phrenological demonstrations). Combe, as reported by Gibbon, noted that Chalmers had "read the 'Essays on Phrenology' with pleasure, and said they first presented the subject to his mind from a philosophic point of view."[205] In 1823, Combe wrote to Chalmers (then in the chair of moral philosophy at St. Andrews) urging him to give phrenology fair consideration:

> ... you have it in your power to become the first established professor in the Kingdom of whom it could be said that he investigated the new philosophy, appreciated its merits, & had the magnanimity to espouse his cause.[206]

Later he attended Chalmers' lectures in Edinburgh University.[207] Just as he tried with Welsh, Combe evidently hoped to enlist Chalmers as an ally. In 1829, he wrote a fulsome letter from Dublin about a speech made by Chalmers on the question of Catholic Emancipation:

> It strikes me you could do great good by preaching here. Your authority is prodigious, & at this moment they want a

> great liberal mind, to direct their attention to the peaceful spirit of Christianity, which you did with great eloquence & effect at Belfast.[208]

Chalmers' Bridgewater Treatise also attracted some favourable comment fromm Combeists. The Scotsman remarked:

> There is, however, a fine liberal and even generous spirit in the work, which gratifies the reader, and, considering the author's profession and circumstances, there is more of a bold reforming spirit than was to be expected.[209]

Whatever sympathy he had for the faculty psychology, Chalmers was unmoved by efforts to win his sympathy for Combeism. In November 1836, Combe informed Nichol that the Church leader had "pronounced a high eulogium on Mr Scott's book" in his class.[210] In 1840, Chalmers, invited to lecture to the Greenock Mechanics' Institute, went out of his way to dissociate himself from the views of James Simpson, George Combe and Brewster's Chartist brother, Patrick, who had appeared there shortly before. Chalmers referred to them as "the most inveterate opponents of this cause".[211] Scott's strategy of divorcing the organology of phrenology from its religious bearings evidently met with Chalmers' approval:

> But perhaps the most singular attempt to graft infidelity on anything called a science, is by those who associate their denial of the Christian Revelation with the doctrines of Phrenology - as if there were any earthly connexion between the form of the human skull, or its effect upon the human character upon the one hand, and the truth or falsehood of religion upon the other.[212]

Brewster and Fleming seem to have held phrenology in contempt right from the start. In 1821, Brewster returned a phrenological paper to Combe, declining to publish it in the Edinburgh Journal of Science:

> In a Journal like ours where we cannot find Room for one half of the articles sent to us on subjects of substantial and admitted Science, I am sure you must be satisfied, upon

> reflection, that we would neither discharge our duty to ourselves or to our readers if we were to print papers on a subject of such uncertainty[213]

In 1827, Brewster, in a letter to a female friend, was prematurely anticipating the downfall of the new science as a result of Sir William Hamilton's challenge:

> Phrenology is to be annihilated tomorrow evening at the Royal Society, and all Edinburgh is to witness its last agonies. You will see by the accompanying Billet that all this is true, and you must now renounce the Heresy.[214]

Phrenology did not go away so easily and Brewster continued to attack both it and its derivatives, such as phreno-mesmerism, which combined the faculty psychology of Gall with Anton Mesmer's doctrine of a universal force which enhanced life (also called animal magnetism).[215] In his review of Roget's Bridgewater Treatise Brewster denied the possibility of investigating the mind/brain relationship at all:

> What the mind is, and how the brain acts as its organ, it is in vain to enquire. The all-wise Creator has placed here a barrier to human genius, and man exhibits only his weakness when he presumptuously attempts to surmount it.[216]

In a letter to Macvey Napier in 1838, he referred to the "absurd system" of animal magnetism, likening the activities of its devotees and of phrenologists to those of the alchemists.[217] Vestiges of the Natural History of Creation, evidently the work of a phrenologist, provoked further attacks on phrenology and its "twin sister", animal magnetism. Brewster thought that female minds were peculiarly easy prey to phrenological heresies. He denied that either side of the correspondence which phrenologists claimed to detect between character and cerebral development could in reality be measured. Not only was its cranioscopy defective in assuming a perfect proportion between the size and development of an area of the brain and those of

the corresponding area of the external cranium. Phrenologists were also in error, and indeed guilty of impiety, in claiming to know a person's true character.[218] Brewster's abhorrence of the occult forces of animal magnetism was such that he rejected Sir John Herschel's suggestion that the sun might be permanently charged with electricity on the grounds that "if we once admit Magnetism and Electricity as agents in our Sidereal systems, the Mesmerists and Phrenologists will form an alliance with the Astrologer, and again denigrate with their sorceries those hallowed regions on which the wizard and the conjuror have long ceased to tread."[219] In an article of 1863 he grouped together a longer list of false sciences: phrenology, physiognomy, magnetoscopy, which measured the strength of the phrenological organs by the range of a pendulum's swing, and glossology, which studied the appearance of the tongue as a clue to the patient's state of health. He also condemned spirit rappers and spirit raisers.[220]

Fleming, whose library included copies of George Combe's Essays on Phrenology, the first edition of the Constitution of Man and Andrew Combe's Physiology applied to Health and Education[221] was also contemptuous of the faculty psychology. "You know that I hold phrenology in scorn," he wrote to Dr. Patrick Neill in 1835. The Evangelical professor acknowledged that a stronger physiological basis to the study of mental phenomena was desirable. However

> ... if Combe believes in the soundness of his logic, I believe that he does not know what correct reasoning is. His facts are generally assumptions, simple probabilities, and not very strong, and are made use of as certainties, and he is continually reasoning in a circle.[222]

Miller was much interested from a literary point of view in human character and psychology. In My Schools and Schoolmasters, in a

discussion of the minds of mental defectives, he remarked on the fragmentary nature of their personalities, with some capacities highly developed and others entirely absent. This told against those metaphysicians "who represent mind as a power not manifested in contemporaneous and separate faculties, but as existing in consecutive states."[223] This did not necessarily associate Miller with phrenology. Indeed, Chalmers, in his Bridgewater Treatise had been agnostic on the question of whether the mind was to be understood in terms of separate faculties or in terms of a succession of states.[224] In First Impressions of England, Miller opposed the doctrine of the hereditary transmission of character, associating it with phrenology and noting that "many who do not subscribe to the creed of the phrenologist, are yet unconsciously influenced by its doctrines".[225] Miller made very plain his distaste for Combe's teachings, seeing the phrenological leader as one of several popular philosophers who were doing much harm in Scotland during the 1840s:

> It is, however, not mainly with the Establishment that the Free Church has to contend. We ask the reader whether he has not marked within the last few years the debut of another and more formidable antagonist with which all Christian Churches may soon be called to grapple. Our newly instituted Athenaeums and Philosophical Associations form one of the novel features of the time - institutions in which at least the second-class men of the age - Emersons, and Morells and Combes - with much that is interesting in science and fascinating in literature, blend sentiments at direct variance with the great doctrinal truths embodied in our Standards.[226]

I now consider how the education issue fared after the Disruption. In the 1830s and 1840s, successive Governments failed to find a solution to the educational issue satisfactory to the various religious denominations. The Free Church found itself in an odd position since its ministers insisted that they were not Voluntaries

and indeed claimed to be the true national church. Yet, as a result of the revival of the Test Acts, schoolmasters who joined the Free Church were dismissed. Reluctantly, Free Churchmen were obliged to admit that their position was similar to that of the United Presbyterians and of other Dissenting bodies. Immediately after the Disruption, the Free Church established many schools of its own. It quickly ran short of funds, and in 1846 accepted Government aid towards the cost of school building, under a new scheme which provided help for all denominations. However, some of its leading ministers and laymen, including the Rev. Thomas Guthrie, the Rev. James Begg, Miller, and Brewster, became converted to the idea of inter-denominational schools. They felt that such a scheme would minimise sectarian bickering and that it was the best available compromise. Some in the Free Church regarded it as a threat to doctrinal purity.

In a paper written near the end of his life, Chalmers accepted that, in a sectarian age, the bonds linking Church and school must be weakened where the state was also involved. Chalmers stressed that he would not require a certificate indicating approval of scholars' religious progress from the school's managers as a condition of its receiving government aid. This would put the administration in the position of approving, for instance, the teaching of the Catholic or Unitarian faiths and indeed "of requiring, that these shall be taught to the children who attend." Chalmers preferred a more permissive system in which parents were able to choose which parts of the curriculum their children should be taught. No child could be forced to learn any particular creed. He stressed that his proposals were not the best possible but the best that could be hoped for in a

Christian world "now broken up into sects and parties innumerable, and seemingly incapable of any effort for so healing these wretched divisions as to present the rulers of our country with aught like such a clear and unequivocal majority in favour of what is good and true, as might at once determine them to fix upon and to espouse it." Chalmers remained a firm supporter of the Establishment principle, convinced that the only effective way to spread Christianity among the people was "through the medium of a Government themselves Christian, and endowing the true religion". However under the compromise scheme, the matter of religion would be left "entire to the parties who had to do with the erection and management of the schools".[227]

Miller's interpretation of Chalmers' proposals was in the spirit of the non-intrusionist principles which had given birth to the Free Church. He proposed a broad franchise encompassing the majority of householders, who would be permitted to select the parish schoolmaster. Miller was confident that this would provide the country with teachers consisting mostly of good Presbyterians, since he believed the population of Scotland to be predominantly evangelical. Whilst taking to task Free Churchmen who made doctrinal purity an obstacle to the state's duty to educate its citizens, Miller made clear that his proposals did not signify a rapprochement with Combe and the advocates of secular education. Indeed, the denominational system, under which any religious sect might receive a government grant for its schools, was objectionable precisely because it might involve state support for the dissemination of heresy:

> The Combeite might then freely come forward to teach at the public expense, that no other soul of man has yet been ascertained to exist than the human brain, and no other

> superintending Providence than the blind laws of insensate matter.[228]

Miller noted Combe's view that the cause of secular education was lost if the Bible and the Shorter Catechism were not actually barred by law from the national schools:

> ... for, if not stringently prohibited, what Parliament merely omits doing, a Bible and Catechism loving people will to a certainty do; and the conscience of the Phrenologist and his followers will not fail to be outraged by the spectacle of Bible classes in the national schools, and of State schoolmasters instilling into the youthful mind, by means of the Shorter Catechism, the doctrine of original sin and the work of the Spirit.[229]

Brewster, like Miller, was appalled by the possibility that a concern for the precise form of religious education would leave large numbers of children without any education at all. In a letter of 1850 to Adam Black, he expressed his support for a meeting on national (i.e. inter-denominational) education, remarking:

> The Men who make the Interests of Religion a ground for opposing this measure, are virtually resisting the Religious education of the People, and depriving thousands of their fellow countrymen of the power of reading their Bibles.[230]

During the 1850s, Brewster frequently called for a greater and more effective diffusion of knowledge, especially scientific knowledge. In his lecture to the Edinburgh Philosophical Institution (1851), he compared the state's duty to educate its citizens with its duty to provide food. Brewster demanded "some comprehensive plan ... for placing within the reach of all that system of ocular teaching, which sitmulates the indolent to study and compels the ignorant to inquire."[231] In his Presidential Address at the 1850 meeting of the British Association, he drew attention to the dangers of increasing man's physical capabilities without correspondingly enhancing his moral and social condition. Brewster advocated "a system of national

instruction, which shall either reconcile or disregard those hostile influences under which the people are now perishing for lack of knowledge."[232]

During the 1850s, denominational feuding held back educational reform to the frustration of both Free Church advocates of liberalising the parish schools and the supporters of purely secular education. The Government measure of 1846 to provide funds for the schools of all sects was condemned by Combe as the desertion of "the shrine of reason and of moral and religious principle", in favour of that of "prejudice and bigotry".[233] In 1850, William Johnson Fox, MP for Oldham and one of the organisers of the Anti-Corn Law League, brought a Bill before the House of Commons which would have provided free schools for children between the ages of seven and thirteen, religious instruction being given outside the schools. Opponents correctly recognised the influence of Combe and Simpson in the measure, which was overwhelmingly defeated. The Combeists also responded to the increasingly sectarian atmosphere by founding schools of their own. In London, William Ellis, an associate of Combe, established the Birkbeck Schools, which provided an exemplar for the Secular School started by William Mattieu Williams in Edinburgh in 1848. The school, according to its advertisements, taught no "Catechisms or peculiar Religious Doctrines" but differed from the Birkbeck Schools in including the systematic teaching of phrenology in the curriculum.[234] Combe was pessimistic about its chances of success. He wrote to Wiliams:

> In this city evangelical religion is strong, active, and penetrating; and it uses all means to command every class of the inhabitants. It will oppose our school, through sheer fear of the theological outcry, although many wish us well. Mr. Robert Chambers, for example, is entirely with

> us in point of principle, and detail, yet in a note he wrote to me yesterday, he says that we shall fail, and he will not countenance us. This "fear of folk" operates irresistibly in the class of persons from whom you desire to draw the pupils, viz, clerks and superior mechanics. They tremble before their evangelical masters and clergymen. It is therefore a problem whether we shall obtain pupils at all.[235]

His forecast was unduly gloomy. Four months after its formation it had 42 pupils and, by November 1849, this number had grown to 160. Combe, who taught physiology and phrenology to boys in the school, held that it was establishments like these which were "the true method of promoting the extension of the political franchise to the working classes."[236] The school remained in existence until 1854, when Williams moved to Birmingham.

The Free Church pursued a parliamentary solution. Lord Moncrieff, the Lord Advocate and an elder in the Free Church introduced a bill in 1854 and on several subsequent occasions until it eventually became law in 1861. The Act incereased the state's provision for teachers' salaries and for their schoolhouses. It also reduced the Church of Scotland's control of the parish schools, transferring the right to examine new teachers from the presbyteries to four boards linked with the universities. Doctrinal tests practically disappeared, the requirement that teachers should not teach anything which contradicted the Bible or the Shorter Catechism replacing the need to sign the Confession of Faith. In 1851, the Free Church was supporting 712 schools of its own but this had already fallen during the next decade and after 1861 it declined further as Free Churchmen were allowed to teach in the parish schools.[237] The liberalising of these schools and the increase of government funding still left large numbers of children in Scotland

without any education at all and a much greater number without any secondary schooling. It was not until 1872 that further legislation was enacted to make education compulsory between the ages of 5 and 13, to transfer financial responsibility for schools from heritors to ratepayers and to provide for the establishment of elected school boards. Religious instruction was to be given at times when it would not interfere with other teaching and parents were free to withdraw their children from it.

The Scottish school system had moved a long way from the pre-Disruption position. It had increased dramatically in size and the Established Church was now only one of several different denominations exerting (now limited) influence. However, education had by no means become totally secular or even non-sectarian. Church schools could be transferred to the control of school boards and those which were not transferred could continue to receive government grants if they attained a certain standard. In the 1860s, some United Presbyterians had made common cause with English non-conformists in advocating a totally secular system similar to that in America. However, even their Church stopped short of asking for the Bible to be excluded from schools. Thus Combe's ideal of a national system of secular instruction was not realised. Even his former allies in the Dissenting Churches did not go all the way with their English counterparts like R.W. Dale, a Congregational minister and co-founder of the National Educational League, which campaigned for the removal of all direct church influence.[238]

While British phrenology had a strong association with secularism and social meliorism, it is evident that the phrenological seed developed in more than one type of soil. Initially it seems to

have germinated in the groves of orthodox Calvinism as vigorously as it did in the hothouses of rationalism and deism. The Evangelical party initially defended phrenology and approved William Scott's strategy of divorcing the organology from Combe's doctrine of the natural laws. Tactical considerations no doubt influenced this decision. If the dangerous parts of Combe's teaching could be refuted without worrying about the faculty psychology, why bother to destroy that too? Perhaps there were also more positive reasons. The Evangelicals had been on the periphery of academic culture during the eighteenth century. The development of the commonsense school of philosophy had largely been the work of Moderate divines and their lay supporters. The mental science of this school paid scant regard to the theology of the Fall. In its most extreme form, Evangelical disapproval manifested itself in accusations that the teachings of Reid and Stewart fostered scepticism. In 1829, the Edinburgh Christian Instructor complained:

> Almost with the single exception of Locke, indeed, our eminent metaphysicians have discussed the moral or religious parts of their favourite science, as if no revelation had ever been given; and have scrupulously avoided connecting it with the truths of Scripture, as if by such an union its dignity would have been impaired, and its utility set aside.[239]

The United Secession Magazine in 1839 spoke of "the semi-infidel prelections, from the Moral Philosophy chair in one of our most influential universities, to which we were doomed day after day to listen."[240]

As we saw in chapter four, Chalmers was far from wanting to tear down the whole edifice that the commonsense philosophers had built. However, he was concerned to show how many mental principles were basic tendencies of our nature rather than products of man's own

devising. Chalmerian psychology emphasised the continuity between man's lower instincts and those of animals, contrasting with the commonsense philosophers' stress on human virtue and dignity. For instance, Chalmers maintained that human anger was the same as that shown by animals. He disagreed with Reid's view that it involved a moral judgement.[241] Fleming, similarly, narrowed the gap between man and animals in a discussion of the human condition prior to the influences of civilisation and religion. He argued that man's great superiority over other species consisted of "a superior degree of perfection in his intellectual faculties", of "a greater power of restraint over his instincts" and of "readier methods of communicating his ideas and feelings" rather than in any inherent difference in the nature of the mental constitution.[242]

To the orthodox Calvinist, human nature contained a capability for moral improvement but man was born a sinful creature and would remain one without spiritual influences. Some Evangelicals were undoubtedly attracted to a psychological theory which provided a material basis for their theology. Phrenology was perceived to offer proof of the Fall of man by showing him to possess animal propensities which were larger than the moral sentiments and intellect. Here was a truth which could be grasped even by the uneducated. The radical empiricism of phrenology had its appeal for a Church party which addressed itself to the farm labourer and the factory worker.

Not all Evangelicals could accept the experiment with phrenology to which Welsh and Buchanan so enthusiastically committed themselves. Brewster and Fleming belonged to elite institutions such as the Royal Society of Edinburgh, where phrenology was an object of ridicule.

Fleming also had close ties with Edinburgh anatomists such as John Barclay, who, as Shapin suggests, saw phrenologists as a threat to their expertise in cerebral dissection.[243] For Brewster, phrenology fell into still greater disgrace when some of its devotees began to combine it with mesmerism, which postulated the existence of occult forces and fluids. If the luminiferous ether was not welcome in the temple of science, even less so were these new and shadowy intruders.

There was no inherent link between phrenology and scepticism. Though phrenology was concerned with the physical basis of mental phenomena, in Britain it was not necessarily equated with materialism. I disagree with de Giustino's view that Christian phrenology was an intrinsically unpromising project. The debates in the Phrenological Society of Edinburgh during the 1820s provide a fascinating glimpse of the social uses of knowledge being developed and argued over. In a sense, Cantor and Shapin are both right in that there was at that time no consensus view amongst the phrenologists about the social and theological implications of their subject. Even Combe, in his early writings, played down these implications. However, it is probable that Combe's faction was always the majority and that many British phrenologists were attracted to phrenology for the optimistic and anti-clerical interpretation which Spurzheim had already given to it. Undoubtedly, this interpretation eventually predominated, both in Scotland and in England.

For Combe, Simpson, and many other converts, Spurzheim's teaching was the means by which they threw off the yoke of a Calvinist background. The doctrine of the supremacy of the moral sentiments and intellect provided the explanation of how the world

could be both disordered and unhappy yet capable of indefinite progress. It removed the huge obstacle of the Fall from the path of education and moral improvement. In his deism, his faith in natural laws as the basis of morality, Combe reproduced the doctrines of French philosophes. Opponents were quick to point this out, anxious to link Combe's name with revolutionary violence. In the different constitutional setting of nineteenth century Britain, this accusation was hardly fair. Combe preferred to be seen as a natural theologian continuing the work of Paley. However, having freed themselves from the thrall of their Calvinist past, Combe and his supporters set about challenging the clerical influence which they perceived to be widely diffused throughout Scotland's institutions, particularly its schools. Combe's deistic natural theology became a convenient weapon with which to assail the Established Church. Many of the Combeists' claims about clerical attitudes were highly exaggerated. For instance, Combe overstated the extent to which the clergy advocated acquiescence in pain and disease and underestimated their interest in scientific education. The parish schools offered little in the way of scientific education but this reflected more on the lack of finance and the low quality of teaching than on clerical attitudes to science. The conflict between Combeists and clergy over the control of education was especially intense in the realm of elementary education, where the Church had long had its own way. Educational politics provide an explanation for the surprisingly favourable response to Combe's teachings amongst the Presbyterian Dissenters during the 1830s. The willingness of some of their clergymen to give Combe a testimonial for the logic chair in 1836 shows that an evangelical view of the Gospel did not automatically produce a

hostile reaction to the "natural laws". Any reservations the Dissenters had about the theology of Combe and Simpson were overridden by enthusiasm for proposals to take schools out of the hands of the Established Church. By the 1840s, the Dissenting clergy had changed their minds. Probably, Combe's increasing boldness in challenging Christian doctrine had convinced them that he was a dangerous and unreliable ally. Moreover, the Disruption brought some re-alignment in ecclesiastical politics; Free Churchmen and United Presbyterians recognised that they laboured in a common cause and the discussions which led to their eventual union in 1900 began as early as 1855.[244]

Over other areas of education - infant and ragged schools, and mechanics' institutes - the parties were not always in conflict. In all these areas, the Evangelicals had no long-standing institutional investment. All three types of institution were novel. Moreover, the clientele of the infant and ragged schools was of a very particular type. Pupils were either very young or very poor or both. It was easier to accept that, in such cases, purely spiritual remedies were inappropriate, and this concession on the Evangelicals' part enabled some initial co-operation amongst educators of differing views. However, even in these areas there were outbreaks of sectarian feuding.

For the Combeists, the re-modelling of man was to take place from the surface inwards. This was a complete inversion of Evangelical priorities. Only in the political economy of Malthus and Chalmers and, to a limited extent, in temperance principles, were there points of overlap. Where the Combeists placed physical phenomena and behaviour at the top of a hierarchy, the Evangelicals'

hierarchy had spiritual health at the top. The two parties not only inverted each other's hierarchies, but effectively removed the top layer from each. The Combeists did not actually deny the reality of spiritual phenomena but behaved as if they were unimportant. Although they were careful not openly to avow materialism, their philosophy was thoroughly materialistic in its emphasis. The Evangelicals, by contrast, refused to acknowledge that the principles of physical heath were moral rules at all.

Cooter has suggested that the concern with the body and its physiology in nineteenth century popular literature demonstrates the potency of this image in promoting social consensus.[245] Society, interpreted through the metaphor of the body, emerged as a harmonious interplay of mutually dependent parts. Such a comforting image obscured the realities of exploitation, inequality and class conflict from a working class audience which eagerly consumed these physiological tracts. Combeist teachings form an example of such literature. Cooter rejects a conspiratorial theory in which the emergent bourgeoisie 'set out' to hoodwink the labouring classes. The distinction betwen 'real science' and 'ideological science' was not apparent, either to those who generated physiological knowledge or to those who popularised it. Physiology was inherently ideological, providing a biological reinforcement of values, beliefs and assumptions about society. Underlying Cooter's account is the assumption that there is an authentic social reality of exploitation and class conflict, which members of the working class are bound to perceive in the absence of an ideological smokescreen. Where they manifestly failed to perceive it, an account is needed of the ways in which the smokescreen was produced and maintained. I question the

validity of this assumption, partly because it takes a monolithic view of the working class. Skilled workers, with some prospect of upward social mobility, are likely to have perceived the nature of capitalism in a different way from their unskilled brothers. I also feel that Cooter does not adequately explain the ways in which the knowledge itself was ideological.

While not denying the importance of the organismic metaphor in defending a particular view of the social order, I suggest that the literal importance of the body should not be ignored. Phrenology moved from the surface of the skull to inferences about the organs of the brain, which in turn were the key to behaviour and personality. Physiology was an analogue at the level of the whole body. The health of the bodily organs determined the prospects in life of the whole individual. To borrow a phrase from Cooter "the taking of the body" by the Combeists was an act of defiance. It was the staking of a claim to pedagogical expertise in opposition to those traditional guardians of the people's moral welfare, the clergy.

It was invariably contamination with Combeist natural theology and moral philosophy which provoked Evangelical attacks on adult education; the Church was generally willing to accept that mechanics' institutes should be run on liberal non-sectarian principles. The Church and the institutes were not automatically in competition; to attend one did not preclude attending the other. Indeed, there was a recognition that clergyman and lecturer could work in harmony.

The Combeist attempt to claim natural theology as their exclusive property strengthened the determination of Brewster, Miller and other Evangelicals to disseminate a theologically correct view of the natural order. Combe himself concentrated almost exclusively on

the laws of man's mind and body. Although he talked in general terms about the inherently progressive tendency of nature under invariant laws, he did not discuss in detail the origins of the earth or the continuity between man and other animals. In the next chapter, I shall examine extensions of his natural theology into cosmology, geology and biology. I also discuss Evangelical reactions to such cosmic materialism.

Chapter Seven

NATURAL LAW VERSUS DIVINE MIRACLE?

In this chapter I examine a number of issues in nineteenth century science, chiefly in astronomy and geology. In chapters four and five, I discussed the voluntaristic tradition in British theology: the belief that the laws of nature were sustained from moment to moment by the Creator, who could suspend or alter them as He pleased. This removed the need for direct divine intervention in the order of nature as evidence of God's Providential management. Even the most abstract laws of nature, such as Newton's law of gravitation, owed their origin and continuance to the will of God.

We have already seen that the Scottish Evangelicals, although sharing this belief, were unhappy entirely to banish direct divine interference. They were anxious to defend the efficacy of prayer, in the physical as well as the moral realm. During the cholera epidemic of 1832, Chalmers found a way of allowing this without the need for any visible suspension of the laws of nature. In his natural theology, he expressed suspicion of laws which reduced the number of separate dispositions. Indeed, even dispositions did not prove the existence of a Creator without evidence, drawn from geology, that God had miraculously intervened several times to create a new order from the wreck of an old one. The natural theology of Brewster and Miller also depended heavily on the discoveries of geology for proofs of creative intervention. Fleming looked cautiously on all attempts to detect order, plan or law in living nature.

In this chapter I examine in more detail how these concerns

affected the development of Evangelical natural science. I also consider ventures into astronomy, geology and evolutionary theory by members of Combe's circle, especially J.P. Nichol and Robert Chambers. These are shown to have had a significant effect on Evangelical attitudes to 'law' and 'Providence'.

Astronomy and physics had, during the eighteenth century, been exceptionally successful in extending the Newtonian theory of gravitation, so as to reveal any apparent tendency to disorder in the motions of the planets around the sun as periodic rather than progressive. As as a result of the labours of Lagrange and Laplace, natural theologians of the late eighteenth century could represent the solar system as a perfectly running machine, requiring no Providential interference for its occasional repair. In 1810, John Playfair wrote:

> The constancy of Nature, amid all the changes she undergoes, is upheld by the constitution of those changes, which prescribes to each its limits, and forces it to recur in a series, which in time reduces to nothing the sum of all the deviations from this mean. Thus, the amount of the whole is permanent, though the terms themselves are perpetually changing; and hence Nature is rendered immortal, not by emerging from the storm, but by being ever superior to its power, its order is not renovated, but preserved; and the wisdom of its Author has provided an antidote to evil, that renders all remedies unnecessary.[1]

In 1822 and again in 1825 and 1828, the astronomer Encke noticed alterations in the orbit of the comet to which he gave his name, and called into question the permanence of the system. Encke postulated the existence of a resisting medium, a very thinly-dispersed fluid filling the space between the planets. Its effect on the path of a comet would quickly be discernible but it would eventually retard the planets in their motions and cause them to spiral towards the sun.

Most Evangelical writers eventually accepted this discovery, as

did J.P. Nichol on the Combeist side, but interestingly there seems to have been greater reluctance on the part of the Evangelicals. Nichol was able to view the system's dissolution as part of an organic cycle of birth, growth and decay. Partly this can be attributed to the relationship between the new phenomenon and Nichol's existing commitment to the nebular hypothesis. The hypothesis held that the solar system had once been a single rotating cloud of gas, from which the planets and satellites had condensed. A supporter of the nebular theory could treat the resisting medium as residual matter remaining from this process. Nichol was able to set this steady and slow decay in contrast to the more dramatic end to the solar system, envisaged by Newton:

> It [the decay of the solar system] comes, not as Newton thought, by accident, derangement, or disease, but through the midst of harmony; it is an easy consequence of the venerable power which first evolved us, infused our scheme with the spirit of life, and gave it structure and strength. Our supposed origin of the planets gave them and their satellites that kind of orbits and that kind of rotation which caused their permanence; and the inherence of this same Nebulous parentage, viz., the existence of an ether, leads gently to their decline. So dies Nature's unblemished childe - the simple flower! It bursts its seed, buds and blooms, and then in unpained obedience draws in its leaves and sinks into the lap of its Mother Earth.[2]

Brewster was initially sceptical about the resisting medium. In his review of Whewell's Bridgewater Treatise, he regretted the author's dogmatism on the side of Encke's hypothesis. He noted that he was old enough to have lived in "three different ages of astronomical opinion, respecting the stability of our system", the theory of the resisting medium having awakened scientists from the "dream of permanence" associated with the discoveries of Laplace and Lagrange:

> If we then consider the mathematical stability of the Solar

> System as a new argument in favour of Design, we must consider the introduction of a Resisting Medium, which has a tendency to counteract this stability, as an argument against Design. We challenge, therefore, the most ingenious Sophist to construct out of these antagonist principles a formula of gratitude, or to deduce from them any evidence of design.

Brewster declared himself to be, "with some reservation", a believer in "the mathematical stability of the System".[3] By 1835, he seems to have been less sure that permanence was guaranteed, admitting that some cosmic disaster might shatter the illusion:

> In the planetary system, a sun enthroned in the centre of its domains (a sovereign without responsible satellites) governs the different classes of its dependents by its enormous mass, and amid their eccentric movements, and mutual perturbations, contains them into the most perfect obedience. But, in the midst of this universal harmony, the spirit of disorder is not wholly subdued. A comet will still forsake its orbit, a planet will burst, and a star will be struck out of the firmament.[4]

The review did not mention the resisting medium, but by 1844, Brewster had accepted its existence and its consequences for the future of the solar system. Now a supporter of the nebular theory, he was able to locate the process of decay in a cosmic drama of creation and re-creation. It gave substance to the words of the Psalmist about the heavens waxing old like a garment:

> Motion cannot be perpetuated in a resisting medium; and where there exist disturbing forces, there must be primarily derangement, and ultimately ruin. From the great central mass, heat may again be summoned to exhale nebulous matter, - chemical forces may again produce motion, and motion may again generate systems; but - as in the recurring catastrophes which have desolated our earth, the great First Cause must preside at the dawn of each cosmical cycle - and, as in the animal races which were successfully reproduced, new celestial creations, of a nobler form of beauty, and of a higher order of permanence, may yet appear in the sidereal universe.[5]

Other Evangelical commentators wondered whether the loss to one aspect of natural theology represented by an overthrow of the

system's permanence outweighed the gain to another. In 1837, the Church of Scotland Magazine took the Rev. Henry Duncan to task for his readiness to desert Playfair's position:

> The fact of a resisting medium is not proved; resistance may have its counter-agent; the medium may revolve; gravitation may itself be a medium, and yet the cause of motion. At all events, a comet whose head is so thin, that the stars are seen through it, ought not to be received as a competent witness to prove the approaching dissolution of the heavens.[6]

The death of the solar system by the cumulative effects of the medium was acknowledged to be neither unpredictable nor rapid. More to the tastes of Evangelical writers were such cosmic pecularities as the comets and the asteroids (or minor planets). Comets did not fit easily into an orderly and harmonious picture of the solar system. The orbits of most were highly eccentric, and inclined at sharp angles to the plane of the ecliptic. Nor was it easy to explain exactly how such cosmic wanderers had originated in the rotating cloud of gas from which, according to the nebular hypothesis, the planets and their satellites had been formed. The problem was not insuperable to the determined seeker after natural order. Nichol was convinced that the comets subserved some important function, as yet unknown:

> But shall we therefore go into the usual inference, that the comets are merely anomalies - freaks of nature? Because they have no connexion with the order of our planetary worlds, is it necessary that they should have no meaning - no place in the universe? Look around you! What is there, what existing creature, - which has not such a place?[7]

Evangelical writers, whilst they hesitated to restore to the comets the supernatural significance which they had carried in former times, were content to regard them as anomalies, and as possible agents of large-scale cataclysms. Their position was thus midway between the

fully miraculous and the orderly and predictable, serving, like earthquakes and volcanoes, to remind man of the precarious nature of his earthly existence.

In the chapters he contributed to Ferguson's Astronomy (1811), Brewster conjured up a frightening picture of what might happen if a comet were to collide with the earth. The "awful" consequences included a change in the axis of the earth's rotation, the inundation by the sea of existing islands and continents and the destruction of "every vestige of human industry and genius."[8] He then reassured his readers by stressing the extreme improbability of such a collision. We noted in chapter four that a similar strategy of combining precariousness with security was used by Chalmers in his Astronomical Discourses. In a later article (1844), Brewster thought the comets linked our own solar system with another. They were formed of "nebulous matter" which might "yet be consolidated into habitable globes".[9] By 1846, he had given up the nebular hypothesis and with it this reassuring view of the comets. Astronomical catastrophism had returned:

> Comets have passed near the earth, and may pass still nearer; but even if they shall not produce those tremendous effects which even Laplace has indicated and if their great rarity and rapid motion should hinder them from acting upon our seas, or changing the axis of our globe, a sweep of their train of gas or of vapour would not be a pleasing salutation to living beings. We know nothing of the gases or the exhalations which seem to compose these anomalous bodies; they may be acrid, or they may be poisonous, and we should dread more being suffocated by their breath, than stunned by their blows.[10]

If anything, Brewster's forebodings were even gloomier, since in 1811 he had remarked that "the transient effect of a comet passing near the Earth, could scarcely amount to any great convulsion".[11]

Another type of celestial body whose origins offered scope for

quite opposite explanations, was the asteroid or minor planet. These small planets occur mainly between the orbits of Mars and Jupiter, the astronomer, Piazzi, having discovered the first, Ceres, in 1801. By 1837, four were known to exist. Asteroids posed a challenge to an orderly taxonomy of the bodies in the solar system. Unlike the comets, however, they presented a less serious problem once the dimension of time was added. The nebular hypothesis could more readily account for asteroids than it could for comets. Nichol had no need in this case to appeal to hidden connections and undiscovered laws. He could argue that the asteroids had been formed in much the same way as the major planets:

> In one instance only, does the ring seem to have divided into equally balanced parts - I allude to the four small planets, those ASTEROIDS between Mars and Jupiter, which have nearly a common orbit, or which revolve at almost the same distance from the sun.[12]

Although they evidently caused few problems to the determined seeker after natural order, the asteroids also provided scope for the speculations of cosmological catastrophists. Not all evangelical writers shared the caution of the Scottish Christian Journal:

> Some philosophers think them the shivers of an exploded planet - an orb violently disrupted by immense internal force. Ceres, Pallas, Juno, Vesta, Astraea, Hebe - they regard as the larger and our periodic meteors as the smaller fragments of that one exploded world. On this subject we hazard no assertion. Of much concerning these mysterious masses we still are ignorant.[13]

In the 1846 article, Brewster did not hesitate to read moral lessons in their catastrophic origins:

> ... but upon advancing a little farther into space, our pride is rebuked and our fears evoked, when we reach the golgotha of our system, where the relics of a once mighty planet are revolving in dissevered orbits, and warning the vain astronomer of another world, that a similar fate may await his own.[14]

Even while a supporter of the nebular hypothesis, Brewster firmly believed that the asteroids were the remains of former planets: nature's monuments to decay and disaster rather than evidence of a birth that had miscarried.[15] In 1854, he took strong exception to the suggestion in Whewell's Essay on the plurality of worlds that the planetoids were pieces of a planet that had "failed in the making".[16] Brewster regretted that "in a system of worlds so nicely adjusted, a bungled planet should have been found".[17]

If astronomy revealed evidence of a precariously-balanced cosmos, its stability at best temporary, what of the history of our own globe? Two major geognostic schools confronted one another in Scotland in the early nineteenth century. In arguing about geological change, they were distinguished by their different elemental loyalties. The neptunists argued for the primacy of water as a geological agent, the vulcanists for heat. The former were inspired by the teachings of the German geognost, Abraham Gottlob Werner, professor of mineralogy at Freiberg in Saxony. Their leader in Scotland was Robert Jameson, who had studied under Werner and became professor of natural history at Edinburgh University in 1804.[18] Jameson founded the Wernerian Natural History Society in 1808. The Wernerians maintained that all rock formations had been deposited from solution and suspension in water, the primaeval ocean having covered the entire surface of the globe. The earliest rocks - granite, gneiss, porphyry - had crystallized from solution, and later rocks had been formed either chemically or mechanically. Heat was only a minor geological agent. Werner held that in the most recent, post-aqueous period, volcanoes had been activated by the ignition of coal deposits. Volcanic activity had produced only localized lavas,

tuff and similar deposits.

The vulcanists did not deny that water had played a part in geological processes but differed sharply from the Wernerians in maintaining that granite, porphyry and basalt had been formed by the action of heat, rather than crystallization from solution. They also believed that heat, combined with intense pressure, had formed sediments into solid rock. After it had consolidated under the ocean floor, its expansive effects had caused the uplifting of land masses. The founding father of vulcanism was the Edinburgh natural philosopher, James Hutton, who presented his theory to the Royal Society of Edinburgh in 1785[19] An expanded version was published in 1795. Hutton envisaged that geological change was gradual and cyclical. We could find in the earth's history "no vestige of a beginning, no prospect of an end."[20] Hutton died in 1797, having won few converts. However, in John Playfair, professor of natural philosophy in the University, the vulcanists had a far more effective publicist. Playfair's Illustrations of the Huttonian Theory of the Earth was published in 1802.[21]

In the first two decades of the nineteenth century, the Scottish capital was the scene of polemical exchanges between the disciples of fire and those of water. By contrast, English geologists tried to avoid theoretical controversy, the Geological Society of London announcing its determination to collect only "material for future generalisations".[22] Even in Scotland, Porter suggests that the Huttonian theory was exceptional in its concern with geological dynamics. The dominant characteristic of Scottish geology was a concern with the natural history of minerals. The methodology of the Wernerian school followed this Scottish tradition. Huttonianism

represented a new departure.[23]

Werner believed that there were recognisable geological rock formations and that these occurred in a fixed order of superposition everywhere in the earth's crust. He thus sketched the rudiments of a geological chronology. However, at that time virtually nothing was known about the history of life. In 1815, William Smith's stratigraphical map of England and Wales linked particular species of fossils with particular groups of strata.[24] In France, Cuvier[25] and Lamarck[26] established the foundations of vertebrate and invertebrate palaeontology. Robert Jameson edited an English edition of Cuvier's Theory of the Earth (1813).[27] From the 1820s onwards, English geologists like William Buckland, Adam Sedgwick, Henry de la Beche and William Phillips, added greatly to knowledge of the fossils of the Secondary rocks. Geology began to assume a historical character.[28] In Scotland, interest in geognostic theory declined. By about 1820, members of the Wernerian Society were showing a greater willingness to disagree with Werner and some even began to acknowledge the merits of the Huttonian theory. However, this, too had undergone changes. Many who called themselves Huttonians did not adhere to Hutton's theory of gradual, cyclical change but believed that there had been periods of rapid, violent action.

Writing in 1840, William Whewell distinguished geologists into two schools: uniformitarians and catastrophists.[29] These labels were not widely recognised by his contemporaries, although they have been eagerly seized on by some historians. Catastrophists were those who believed that the causes of geological change had in the past been greater in intensity and perhaps even qualitatively different from those now operating. As depicted by Gillispie, for example,

catastrophists believed that the forces which had raised the continents and thrown up great mountain chains must have been very unlike those agencies now in operation. Similarly, gorges, ravines and water gaps cut through mountain masses, and huge deposits of gravel were read as indications of the violent and rapid action of water.[30] Some catastrophists, notably William Buckland, attempted during the 1820s to explain all such spectacular effects of water as the results of one particular event: the Biblical Flood. This form of catastrophism was known as diluvialism.[31] Catastrophists drew further support from palaeontology. Large gulfs apparently existed between the flora and fauna of successive geological epochs, and it could plausibly be argued that several global cataclysms had taken place, wiping out whole races. Each act of destruction had been followed by a new creation.

Strict uniformitarian geologists did not accept that geological change had in the past been different, either in kind or intensity, from that now taking place. The guiding principle of uniformitarianism was that the geologist should invoke as explanatory causes only those agencies which were currently in operation. Given sufficient time, the slow upheaval and depression of land masses and the normal action of wind and water could account for all geological phenomena. The principle was most clearly formulated in Charles Lyell's Principles of Geology (1830-33). Where the catastrophists had been "parsimonious of time and prodigal of violence", Lyell urged geologists to be "prodigal of time and parsimonious of violence".[32]

Gillispie implies that catastrophists needed cataclysms as proof of God's Providential activity in the world:

> If Buckland feared that without Cataclysms there was no God, Lyell was as fundamentally apprehensive lest, without uniformity, there be no science.[33]

Gillispie also links the Wernerians with Biblical diluvialists like Richard Kirwan and Jean Andre Deluc[34] by including all of them in a chapter entitled 'Neptune and the Flood'.[35] He later remarks that diluvial geology had a "Neptunist ancestor".[36] At their most Whiggish, adherents of the Gillispie school hold that Lyell directly anticipated Darwin by clearing away from geology the detritus of Moses and miracle.

Hooykaas,[37] Rudwick,[38] Cannon,[39] Bartholomew,[40] Porter,[41] Rupke[42] and Lawrence[43] are among those who have criticised such an evaluation, which perhaps relies too heavily on Lyell's own propaganda.[44] They stress that catastrophists were not necessarily interested in the Mosaic Flood at all, nor did they necessarily believe that in cataclysmic events the action of secondary causes had been suspended. It is even possible to answer the Whig historian on his own ground. Catastrophists like Buckland, who had emphasised that qualitatively different processes had been in operation in the past, found it much easier than, say, Darwin or Lyell, to accept that some previously puzzling geological phenomena had been produced by the action of ice.[45]

Hooykaas suggests that the important division between uniformitarians and catastrophists was over the question of whether the earth's history exhibited any form of progress or development, rather than over geological causation. Building on this interpretation, Bartholomew argues that Lyell's implacable opposition to any form of species transmutation led him to deny the existence of discernible direction in geological change. The earth's history was

a steady state, changes in temperature and the amount of dry land being mere fluctuations around a mean. This was in sharp contrast to the more widely-held progressionist view of catastrophists like Buckland and Sedgwick. Progressionists (or directionalists, to use Rudwick's term) held that the earth had developed from a primitive physical condition to the varied and relatively tranquil form of the present. The history of life similarly showed that the simplest organisms had appeared first.

Rupke radically re-interprets the meaning of Buckland's catastrophism, denying that "a catastrophist synthesis" ever existed in early nineteenth century England. Rather, the English school was one of historical geology. Its methodology centred on the study of rocks and fossils as records of the earth's history. While Buckland believed that catastrophes had occurred, he had no particular interest in explaining the cause of such events. Moreover, the English school's evidence for such catastrophes came not only from the fossil record and from the present landscape of the earth but also from the extensive conglomerate deposits at the ends of major geological systems. William Conybeare suggested that four such sets of deposits could be traced: above the Transition series, above the Carboniferous, above the Chalk and above the diluvial gravel.[46] The upheavals were not the geological norm but periodic interrruptions to long periods of calm. Rupke further suggests that Buckland's diluvialism was really an attempt to accommodate Cuvierian geology to the traditional regime of classical education at Oxford. His concern for geology to be accepted as a legitimate academic subject caused him to emphasise points of contact with established disciplines, including sacred history.

Lawrence concentrates on the support which the nebular hypothesis, combined wth Fourier's theory of heat, lent to the directionalist view. The nebular hypothesis held that the earth had condensed from a cloud of incandescent gas and so implied that the earth's history involved a cooling process. Some heat still remained, as was shown by the rise in temperature on descending into the earth. However, in the period 1800-15, strong doubts were expressed that there was adequate residual heat to exert much influence on geological events. Fourier's theory indicated that the earth still had a substantial igneous reservoir.[47] In 1828, the French geologist, Elie de Beaumont, put forward a comprehensive theory of geological dynamics, which showed that sudden, violent events, as well as gradual change, were in accord with Fourier's theory.[48] The catastrophists therefore did not need to invoke divine Providence to account for cataclysms. Lawrence suggests that Lyell's uniformitarian or actualist principles were already accepted by "all serious geologists", although he admits that Lyell's actualism was of an extreme kind in allowing the past intensities of geological forces to deviate only slightly from their present levels. The only really radical element in Lyell's theory, according to Lawrence, was his denial of geological progression. There was no place in his synthesis for a gradually cooling earth. Lawrence perhaps exaggerates the degree of consensus amongst geologists, suggesting that "the geological community" rejected Lyell's ideas in favour of those of Elie de Beaumont. Many geologists, like Buckland, probably remained relatively uninterested in the physical causes of geological change. However, Bartholomew agrees with Lawrence that Lyell's non-progressionist view of the fossil record won few supporters.

Detailed examination of the Scottish material shows how inadvisable it is to make simplistic connections between uniformitarianism and evolutionary theory, or between catastrophism and a thoroughly interventionist view of divine activity in geological history. Simple labels do not fit either Evangelical writers or their adversaries. The Combeists might be expected to favour the uniformitarian position in vew of their belief in natural law and their abhorrence of any form of supernatural explanation. However they also believed that the world was progressive and was advancing towards superior forms of organisation; this might have alienated them from the Lyellian steady-state view. The Evangelicals, on the other hand, might be expected to opt for a rather thorough-going catastrophism. However we would expect them to show some nervousness about the possibility that a progressionist view of the fossil record could be mistaken for a theory of species transmutation. We might also expect them to have had doubts about the use of the nebular hypothesis to dispense with direct divine intervention in the earth's physical history.

To some extent these predictions are confirmed. Combeists who wrote about geology tended to favour anti-progressionism. Nichol complained of Buckland's Bridgewater Treatise:

> With one splendid exception [Lyell?], all geologists - Dr Buckland among the number - are still prone to speculate concerning progressive creations, a gradual preparing of the earth for inferior life, &c. &c. while, the truth is, they wholly overlook the circumstances under which these remains are preserved, and thereby miss the conclusion that for aught we know, or perhaps ever can know, our planet, during its former long epochs, may have been as varied and brilliant and teeming with every life as in the present period of its course.[49]

As we saw in chapter six, Combe appealed to geology for evidence that

the world was inherently progressive. However, Hewett Watson warned him that, granting Combe's assumptions (borrowed from Sir Humphry Davy's Consolations in Travel), the science tended to favour divine interference rather than, as Combe wished, a self-sufficient process:

> The premises, however, are probably incorrectly stated. Davy was a Chemist, & wd try to explain everything by Chemistry. Lyell is a better authority for geologic changes. Geological records, interpreted by the present course of nature, rather tend to oppose the notion of divine interference, & those fancied 4 or 5 creations, en masse, of plants & animals.[50]

Watson's letter gives a clue to the reasons for his opposition to progressionism. It was precisely because it had become so strongly associated with miraculous creation that the Combeists were inclined to set the doctrine aside. They rejected progress for precisely the opposite reasons to those of Lyell. As we shall see later, a progressionist reading of the fossil record subsequently made its appearance in Robert Chambers' Vestiges. Even so, in reply to critics, Chambers accepted that the fossil evidence did not straightforwardly favour species transmutation. Like Lyell, although with opposite intentions, Chambers was obliged to emphasise the fragmentary nature of the evidence. Many of the intermediate forms had not been preserved, or remained as yet undiscovered.[51]

The Evangelicals were quite uncompromising in their belief in the absolutely miraculous origin of life on earth. This was so well before Chambers' Vestiges brought the transmutation issue close to home. As Miller declared in The Old Red Sandstone (1841):

> There is no getting rid of miracle in the case, - there is no alternative between creation and metamorphosis. The infidel substitutes progression for Deity; Geology robs him of his god.[52]

To some extent this position resembled that of English geologists

like Buckland and Sedgwick, but they were inclined to express themselves in a more circumspect fashion. Even after Vestiges, Sedgwick maintained that the creation of life was subject to some laws, whilst arguing that they were very different in kind from those that applied to the inorganic realm.[53] The difference may have been only one of semantics, but it does indicate a greater willingness on the part of Scottish Evangelicals to draw a line beyond which conventional scientific explanations could not be applied.

In discussions of geological dynamics, Evangelical writers are sometimes ambiguous over the question of divine intervention. It is occasionally unclear whether they are limiting miraculous intervention to the creation of new species, or extending it to physical changes as well. In chapter four, we noted Chalmers' condemnation of those whose speculations aimed by natural causes "to explain the formation of new systems emerging from the wreck of old ones."[54] Perhaps they felt that it was less important to specify the nature of the cause than to understand the meaning of such events. We also saw that Chalmers linked the present physical decay of the earth to forthcoming acts of destruction and re-creation, which had moral and spiritual significance. Brewster similarly linked geological catastrophes, whatever their cause, to future moral events.

Another factor motivating Brewster in his discussions of geology was undoubtedly Scottish chauvinism. His desire to praise Scottish geologists, inluding Lyell, and to expose the timidity of their English counterparts sometimes resulted in a blurring of the distinction between his own catastrophist, directionalist views and the strict uniformitarianism of Hutton and Lyell. In his review of

Buckland's Bridgewater Treatise, he praised Hutton's Theory of the Earth for the "soundness and ingenuity of its argument"[55] and claimed that Playfair had thrown over "the wild speculations of cosmology ... the reins of mathematical reasoning" guiding them "with all the caution of the inductive philosophy." Yet Brewster interpreted Huttonian geology in terms of "great convulsions of the globe ... the dislocation of its strata ... the upheaving of its molten bowels, and the entombment of its living occupants ... ".[56] Similarly, in an article of 1851, on Lyell's work, he regretted that English philosophers "of powerful minds, and but little tainted with the prejudices of the day" had "refused their allegiance to the leading principles of his work, and even ridiculed the idea of referring to existing causes the former changes on the surface of the earth."[57] Not surprisingly, Brewster particularly singled out a review of Lyell's Principles of Geology in the British Critic, believed to have been written by that timid English philosopher, William Whewell.[58]

Fleming was deeply interested in geological dynamics and regularly criticised Huttonian geology in papers communicated to the Wernerian Natural History Society. In a paper of 1812 on the rocks around Dundee, he noted that sandstone strata were found highly inclined to an underlying bed of porphyry. Whereas the "abettors of the vulcanic hypothesis" argued that all rock strata were originally deposited in a horizontal position, the Wernerians could account for the appearance by their theory that "in strata composed of chemical precipitates, all the variety of inclination depends on the inequality of the bottom".[59] A paper the following year on the mineralogy of the St. Andrews district drew attention to the existence of basalt and amygdaloid enclosed by trap tuff, concluding

that the bed of tuff was "partly a mechanical, and partly a chemical deposit". Hutton would have found "considerable difficulty in applying his heat to these inclosed masses of basalt, without fusing the bed of tuff which surrounds them." The paper ended with a typical piece of Wernerian polemic against the methodological weakness of the rival school:

> He who has the boldness to build a theory of the earth, without a knowledge of the natural history of rocks, will daily meet with facts to puzzle and mortify him.[60]

By 1815, Fleming was willing to acknowledge deficiencies in the Wernerian theory. For instance, it had difficulty accounting for the origin of balls of agate found inside the amygdaloid rocks of the Redhead in Angus. In the same year, he dissented from Werner's view that different rock formations could always be discriminated by their fossils:

> How far this opinion may hold true with respect to the petrifactions of Germany, we have not the means of ascertaining; but in this country it cannot be considered as a general law in the distribution of organic remains.[61]

By 1820, Fleming's retreat from Wernerianism had gone far enough for him to warn that

> ... even the latest and most approved authorities on this subject have pushed their conclusions a great way beyond their actual acquaintance with nature; assuming a uniformity in the collocation of strata, and giving a generality to their doctrines in the relation and succession of different rocks, which a more extensive comparison of facts has, in many cases, compelled them to retract.

Fleming continued to acknowledge Werner's great superiority to Hutton in knowledge of mineralogy. Theoretical generalizations could come later. Now was the time for "examining, mapping, and reporting surveys, of such parts of our country as have not yet been made known."[62] This the Wernerians were well-equipped to do. In another

article of 1820, Fleming expressed his continuing loyalty to their methodology, ascribing to its use "the rapid advances which the science has lately experienced."[63]

Fleming's move was typical of Wernerians in the period, 1815-20. In Fleming's case, he never found another theory to take the place of Werner's. As we saw in chapter five, he believed that theorising was a difficult and error-prone activity. Geognosy, in particular, had suffered greatly in the past from over-exercise of the imagination. So complete was his apostasy from Wernerianism that, by 1850, he could round on the German school for being "indifferent to the truths of palaeontology" and for "outraging all philosophy by the extravagance of its assumptions". Indeed, it had prepared the way for "those reveries of progressive development with which of late years we have been inundated."[64]

Between 1824 and 1826, Fleming rained blows on the diluvial hypothesis, as represented in Buckland's Reliquiae Diluvianae (1823). Buckland believed that alluvium left by the Flood (diluvium) could be distinguished from that attributable to wind and rivers. Diluvial matter, according to Buckland, was composed of fragments torn out of regular strata. It contained the relics of extinct animals. Valleys of denudation had also been formed by the Flood waters. Further support for his theory came from bone caves such as the one at Kirkdale in Yorkshire. It contained a layer of mud which, Buckland argued, could not have been deposited by local floods, because the cave remained dry even after heavy rains. Buckland found in the mud, broken and mixed together, the bones of a number of extinct species of animals.[65]

In answer to the diluvialists, Fleming emphasised the need for

scholars of the earth's history to "commence their investigations with a knowledge of recent events, and proceed by degrees to those of remoter times".[66] In accounting for the extinction of animals he felt that other factors had been undervalued: changes in climate due to the gradually increasing amount of dry land, the effects of disease, of local floods and of man's hunting activities. He argued that flood waters were insufficiently powerful to excavate valleys, and attributed the mud in the Kirkdale cave to an underground river. Whilst not denying that the Biblical Flood had occurred, he believed that it had been an entirely tranquil affair and had not caused any species to become extinct. As for the origin of the Flood waters, he was sceptical, as always, about invoking novel causes:

> Some consider the waters as having been set in motion by the attractive force of a comet, without previously gaining an affirmative answer to the question, Has a comet this attractive force? There is abundant proof that the planets disturb the comets, but the converse is not known.[67]

Page uses Fleming's work as evidence that "there were strong uniformitarian tendencies in Wernerianism that may have facilitated the later acceptance of Lyell's more comprehensive uniformitarian views".[68] Fleming's methodological principle of reasoning from the known to the unkown, of using present day changes to understand the past, was generalised boldly by Lyell. In Principles of Geology, it formed the basis of a kind of geological metaphysics. Fleming did not banish all cataclysmic events from the earth's history in such an unequivocal manner. On many questions he was simply agnostic. He maintained that the earth was in an "unnatural state" in having mountains above and hollows beneath sea level:

> What those causes have been, so much in opposition to the known laws of gravitation, which have produced this unnatural state, we stop not here to inquire.

Geology could, however, concern itself with the processes which brought the earth closer to its ultimate natural state, "a spheroid of equilibrium".[69] A process of abrasion would result in the gradual reduction of the height of mountains and the transport of material towards sea-level, although to some unknown extent this process could be reversed by shore sand-drifts, inundation by the sea (producing raised beaches) and volcanic eruptions. However, Fleming believed that the amount of dry land was always increasing, leading to the destruction of the habitats of certain aquatic species and their consequent extinction. Climatic changes would also result; summers would become hotter, winters colder, although again there could be modifying influences, from vegetation and from volcanic activity.

Fleming also disputed the fossil evidence for the reverse direction of climatic change i.e. that the earth had once been warmer than at present. In 1829, he challenged the directionalist view that the Arctic regions and the temperate zone had once been very much hotter than now. Mammoths had been identified with elephants, the fossil vegetables of the coal measures with contemporary plants found in tropical regions. However, Fleming pointed out that living animals of the same genus did not always have similar habits, citing such examples as the common shrew and the water shrew, the rock-dove and the ring-dove, the rook and the jackdaw. Nor were they necessarily found in similar parts of the world: the existence of the African hare and the Polar hare, the red grouse and the ptarmigan, disproved this. Fleming concluded that evidence was lacking for the belief that the earth had once been red-hot at the surface.[70]

The use of currently-observable processes to study the past, the emphasis on gradual change and the opposition to the notion of a

steadily-cooling earth are all present in Lyell's Principles of Geology. Howver, it seems unlikely that Fleming ever accepted the full Lyellian theory of a steady-state. He praised Lyell's Principles as "a book, exhibiting, in happy combination, agreeable composition and accurate science," but confessed to its author that "on some points I cannot agree with you."[71] Fleming was doubtful about Lyell's (and Hutton's) theory of a periodic elevation and depression of land masses. He was sceptical about claims for the existence of raised beaches around the coasts of Scotland, and criticised Sir John Herschel's claims to have found evidence that Scandinavia was slowly rising from the Baltic.

Fleming explained apparent raised beaches, such as the one between Portobello and Granton, near Edinburgh, as the result of storm action. The occurrence of littoral and deep water shells, mixed up together, supported this interpretation.[72] The topic was one on which he and Miller strongly disagreed. In a letter of 1854 about a forthcoming paper he was to present to the Royal Physical Society on the Filliside raised beach, near Edinburgh, Miller remarked that, though he had taken Fleming to see the deposit, "he still looked as sceptical as ever."[73] In the posthumously-published, Lithology of Edinburgh, Fleming referred to the

> ... hypothetical notions, which unfortunately have passed current in this quarter ... and have been earnestly advocated by such observers as [Charles] Maclaren, Milne Home and Hugh Miller, in which considerable liberties have been taken with molluscan life, on, apparently, very slender acquaintance.[74]

Attempts to assimilate Fleming to a Lyellian or uniformitarian position should therefore be treated sceptically. William Conybeare objected to Fleming's views on the former climate of the Arctic

regions and censured him for disagreeing with Buckland.[75] The Scottish clergyman declared that he was not aware of "any remarkable difference in geological opinion betwixt us [himself and Buckland], with the exception of the "diluvian hypothesis"".[76] This suggests that Fleming identified as much with the English school of historical geology as with Lyell.

Other Evangelical writers quickly accepted Fleming's victory over Buckland. Indeed, as Page points out, Chalmers had, even before Fleming's contributions on the subject, supported the notion of a tranquil flood.[77] Brewster welcomed the freeing of geology from the Mosaic chronology and the notion that "the peaceful deluge of the Scriptures was the only catastrophe to which he [the geologist] durst ascribe the convulsions and dislocations which had everywhere shaken the interior of the earth."[78] Miller's early writings contain little discussion of geological dynamics. Geikie suggests that he was late in acquiring detailed knowledge of the Huttonian theory.[79] However, in an item in the Witness in 1845, Miller displayed something of Fleming's aversion to gratuitous cataclysms. Miller suggested that disease, rather than "some great geological catastrophe difficult to realize" might account for the destruction of extinct elephants, whose remains had been found in Siberia, and of gigantic mastodons found in the alluvium of the La Plate and the Irawadi.[80]

In the 1840s, British geological opinion divided along new lines over the glacial theory.[81] Influenced by Louis Agassiz, who visited Britain in 1840, Buckland became an enthusiastic advocate of the idea that sheets of ice had once covered a substantial area of Europe. In a tour of Scotland, the two geologists found many signs of glacial action: erratics (large, isolated boulders), moraines (isolated

deposits of gravel and other material) and polished rock surfaces. Visiting Glen Roy, Agassiz produced a new explanation for its famous Parallel Roads; they were not raised sea beaches, as Charles Darwin had suggested, but the former shores of a lake which had been dammed by ice.[82]

Contrary to both strict actualism and to the belief in a progressively cooling earth, Agassiz's glacial theory created new alliances and divisions. Supporters included Robert Jameson, who, according to Davies, had believed, even before 1840, that there were signs of glacial action in Scotland, and Charles Maclaren, editor of the Scotsman. J.D. Forbes lent weight to the theory by his studies of the physical processes underlying the spread of glaciers. Lyell was also, briefly, a convert. One of the theory's strongest opponents was Sir Roderick Murchison, who maintained that most erratics had been transported to their present locations by icebergs, combined with waves of translation. The debris carried along by the waves, together with grounded icebergs, had cut all striations, apart from those close to modern glaciers.

Most British geologists took a position somewhere between the two extremes represented by Agassiz and Murchison. They could accept that glaciers had once extended beyond their present boundaries but found less palatable the notion that most of northern Europe had been covered by a huge ice-sheet, an event for which there was no climatological explanation. The ice-sheet theory was therefore augmented by the hypothesis of a recent submergence of the land when icebergs had produced many of the effects which Agassiz attributed to glaciers.

Rupke identifies Fleming as one of those former adversaries with

whom Buckland found himself in unwonted alliance over the glacial theory.[83] However, Fleming was at best a very cautious supporter either of the iceberg or of the ice-sheet theory. In a letter written to Lyell in 1840, he described his position as follows:

> The evidence respecting the transporting power of icebergs is to a certain extent satisfactory, but the transfer of our diluvia into drift is I fear rather unceremoniously ? extended. It would however require more space and time than can be found at present to state my objections. Besides, I am more inclined at present to observe than speculate.[84]

In the Lithology of Edinburgh Fleming accepted that excavations such as Duddingston Loch, Hunter's Bog, Dunsappie and Lochend were the work of an "abrading agent" moving in an easterly direction.[85] He deprecated the fashion "with a certain class of speculative geologists of late" to assume that the land had been submerged, the hollows resulting from the action of oceanic currents, assisted by huge icebergs.[86] The character of the valleys of abrasion, with hard rocks facing the west and the soft, protected matter on the other side (the phenomenon of 'crag and tail') was inconsistent with the effects which ocean currents would have produced. Water had certainly passed over the district at high speed from west to east, probably at successive intervals. However, Fleming viewed cautiously the evidence for the action of ice. Some supposedly glacial phenomena were inexplicable by either version of the theory. For instance, some erratics could not possibly have reached their present position as a result of transport by ice.[87] Fleming repeated warnings he had sounded at the time of the diluvial controversy about the need for careful and thorough study of the superficial strata. The tendency to premature generalisation remained a weakness of many contemporary geologists.

Miller, like many British geologists, advocated a combination of the iceberg and the glacial theory. His Sketch-book of Popular Geology argued that the two were not in any way antagonistic. Indeed, they

> ... ought rather to be regarded as equally indispensable parts of one and the same theory, - parts which, when separated, leave a vast amount of residual phenomena to puzzle and perplex, that we find fully accounted for by their conjunction.[88]

Miller believed that many Highland glens, including Glencoe, contained clear indications of having once contained glaciers. Some of their effects, such as lateral and transverse moraines of detached rock and gravel accumulating along their sides and at their lower ends, had subsequently been removed by ocean currents sweeping over the country. This might have been at the time of complete submergence, when icebergs had produced their characteristic effects, or at a later period of partial subsidence, when a milder climate had prevailed.[89]

The final geological issue I want to consider is the Evangelical view about the existence of a progression in the appearance of life on earth. Most, though not all, progressionists believed that the first invertebrates had appeared before the first vertebrates, but the main interest was the alleged progression in the history of the vertebrate classes. Thus the first fish were believed to have preceded the first reptiles and the first reptiles to have appeared before the first mammals. Bowler has divided into two distinct schools palaeontologists of the early nineteenth century who accepted the notion of progression.[90] There were those like Sedgwick and Buckland who were primarily committed to the notion of progression in the earth's physical history. The progression among the classes was

merely a consequence of these physical changes. There was no special emphasis on the progressive tendency in organic forms, the main theological stress being on the Paleyan notion of the perfect adaptation of each species to its environment. Other progressionists, notably Agassiz, took a much more man-centred view of the process, seeing it as the gradual unfolding of a plan in the mind of the Creator. The appearance of man was its final goal.

Ospovat emphasises that the move in natural theology from concern with perfect adaptation to a concern with order and pattern in nature reflected developments in morphology.[91] By the 1830s, some British biologists had begun to recognise that organic structures could not always be explained only in relation to their function. Sometimes it was necessary to invoke conformity to a general pattern. Similar structures could be found carrying out very different functions in different animals. Richard Owen's On the Nature of Limbs (1849) was one of the works which highlighted the problems of functional explanation.[92] The move away from teleology represented a break with Cuvier's principles in favour of those advocated by his great rival, Geoffroy St. Hilaire, who was a transmutationist.[93] Amongst the German Naturphilosophen such as Lorenz Oken, the idea of a unity of type running through the vertebrate creation was ascribed to the workings of a world spirit.[94] Although the rejection of teleology was thus sometimes linked with deism or pantheism, this was not always the case. Nor was it an inevitable step from recognising unity of pattern to espousing a theory of species transmutation. Progress either in the physical or in the organic world did not necessarily entail development by natural law. Sedgwick, Buckland, from the "physical" school, and Agassiz, from the "transcendental"

school, all firmly opposed such an inference. Buckland pointed out that there was no evidence of progression within the classes. Some of the most highly developed forms within a class had appeared early, and indeed in the case of fish "a kind of retrograde development, from complex to simple forms, may be said to have taken place".[95] Although Agassiz maintained that there was a continuous thread running through the whole of the vertebrate creation up to and including man himself, he held that the realisation of this plan lent no support to the transmutationists. The links existed in the Creator's grand design, rather than in the temporal sequence of living forms.[96] Agassiz remained opposed to the development theory even when, later in his career, he moved towards a more continuous view of the history of life. For a time he became very interested in the notion of 'ontogeny recapitulating phylogeny', the idea that the development of the individual reproduced the arrangement of the species in the overall plan.[97]

Examination of Evangelical writings on the fossil record shows a firm insistence on discontinuous progression. In 1823, that cautious theoriser, John Fleming, accepted as "in a very general point of view, an approximation to the truth" Werner's view that

> ... the petrifications of the older rocks belong to animals of more simple structure and less perfect organisation, than those which occur in the recent deposits.[98]

No traces of vertebrate animals had been found amongst the transition rocks, the oldest ones known to contain fossils. However, in an earlier attack on the materialism of Lamarck's Invertebrate Animals, Fleming had been cautious about admitting any sort of chronological progression:

> ... the existence of an ascending scale, from the more

> simple to the more complex animal structures does not necessarily imply, that the different tribes of living creatures were successively produced in that order, or that nature was compelled to limit her efforts to the scanty and imperfect, before she could progressively advance to the more ample and finished forms.[99]

In chapter five, we noted Fleming's hostility to the principle of continuity in nature. The evidence for progression had to be received cautiously, and even if accepted, was no proof of a parental relationship between kindred species.

For Miller, the moral and theological significance of geology derived from the progress which could be discerned in the history of life. This emphasis on organic, rather than physical progression, identified him with the 'transcendental' school. As we saw in chapter five, Miller also admired the emphasis on unity of type in the work of Agassiz and Owen. He began to develop his progressionist ideas in The Old Red Sandstone (1841), noting that fish appeared before reptiles, and reptiles probably preceded birds, just as crustaceans had come before reptiles and annelids before crustaceans.[100] He also reproduced the suggestions of Friedrich Tiedemann[101] and Antoine Serres[102] that the foetal brain of mammals passed in succession through the forms characteristic of fish, reptiles and birds. A further observation, made by Agassiz, was that the foetal development of present-day fish seemed to recapitulate the history of the class, the embryo of the salmon exhibiting the asymmetrical tail found in the more ancient fish. Miller remarked:

> Is there nothing wonderful in analogies such as these, - analogies that point through the embryos of the present time to the womb of Nature, big with its multitudinous forms of being? Are they charged with no such nice evidence as a Butler would delight to contemplate, regarding that unique style of Deity, if I may so express myself, which runs through all his works, whether we

> consider Him as God of Nature or Author of Revelation? In this style of type and symbol did He reveal Himself of old to His chosen people: in this style of allegory and parable did He again address Himself to them when He sojourned among them on earth.[103]

Miller was aware that such a progression in the history of life could be grist to the mill of a transmutationist. He poured scorn on Lamarck's principle of improvement and adaptation, conflating it with the "philosophical romance "of the earlier writer, de Maillet.[104] However, Miller also took care to point out that, apart from the absence of a satisfactory causal agent of species change, the notion was unsupported by the fossil evidence. Miller believed that the earliest fishes - those of the late Silurian and the Old Red Sandstone - were of a very highly developed type. The evidence for this assertion came mainly from the development of their brains and nervous system. He set his face firmly against any recognition of a gradual advance within the fish or indeed any of the vertebrate classes:

> If fish rose into reptiles, it must have been by sudden transformation, - it must have been as if a man who had stood still for half a lifetime should bestir himself all at once, and take seven leagues at a stride.[105]

The only sense in which Miller was prepared to admit the existence of a progression in ichthyic history was of a gradual increase in size. He suggested that this might have been due to changes in temperature:

> If their organisation was in no degree more perfect than at first, their bulk at least had become immensely more Great ... The shark and the sword-fish began to exist as little creatures of a span in length, they expand into monsters whose bodies equal in hugeness the trunks of ancient oaks; and thus has it been with the order to which they belong.[106]

However, even this claim was soon withdrawn because of the discovery by Robert Dick of large fossil fish in the Old Red. The announcement

that "there were giants among the dwarfs" first appeared in the third edition (1846) of the Old Red Sandstone, a convenient piece of additional ammunition against Vestiges.[107]

Before dealing with Vestiges, a realisation of Miller's fears, we need to consider the significance of the nebular hypothesis. This was also a theory of creation, although it applied only to the inorganic realm. One of the people closely associated with the hypothesis was a member of Combe's circle, J.P. Nichol.

Nichol's works brought together two distinct strands of the nebular theory, one deriving from the work of Pierre Simon Laplace, the other from Sir William Herschel. Seeking to explain the origins of our own solar system, Laplace suggested that the solar atmosphere had once extended beyond the orbits of all the planets and had contracted gradually to its present limits. As the entire mass of the solar system rotated, centrifugal force would from time to time exceed gravitational force, causing a ring to separate from the inner mass. Although for a time the forces would then remain in balance, eventually there would be inequality again and another ring would be formed. Laplace supposed that from these rings, the planets had condensed. Satellites were formed in a similar way from the planetary atmospheres. Laplace admitted that the hypothesis was a mere speculation but thought that it could account qualitatively for many of the regularities in the solar system. For instance it could explain the planets' motion around the sun in nearly the same plane and in the same direction, and the motion of satellites in the same direction as the planets around which they rotate.[108] Subsequently, Auguste Comte tried to show that the stability of the solar system, held by natural theologians to result from the precision with which

the Creator had arranged its component parts, was actually a consequence of its mode of formation. Comte, a vastly inferior mathematician to Laplace, thought he had shown that the periods of the planetary orbits could be calculated a priori, given the assumptions of the nebular theory.[109]

Herschel's concerns were different from those of Laplace. He had devoted much of his career to observing the luminous patches or "nebulae" in the heavens. Many of them he had succeeded in resolving into stars, showing them to be very distant star-clusters. For a time he believed that all nebulae consisted of stars and that only the limitations of the available telescopes prevented the more remote clusters from being resolved. Later he changed his mind, influenced by the discovery of what he termed nebulous stars: apparently stellar objects surrounded by a dim, milky light like that of the unresolved clusters. Herschel reasoned that if a nebulous star were really composed of stars there were two possibilities, both unlikely. It must either be a remote cluster surrounding a central body of enormous size, or an object much closer to us consisting of an ordinary star surrounded by other stars so extremely close together as to remain unresolved. Either possibility seemed anomalous, and instead Herschel suggested that the nebulous stars were composed of a fluid, the primordial substance from which all stars had originally been formed.

Comets, the tails of which were known to consist of very thinly dispersed vapour, gave added plausibility to the existence of the nebulous fluid. So too did the zodiacal light, a cone-shaped light sometimes seen extending from the sun along the ecliptic, visible before sunrise and after sunset and attributed to thinly diffused

matter in the solar system's central plane. Herschel supposed that at least some of the unresolved nebulae might consist of nebulous fluid, and, following Laplace, he suggested that these were the parents of solar systems like our own. The nebulous stars represented an intermediate stage in the process of condensation.[110]

Nichol's writings, beginning with an article for the Westminister Review in 1836, helped to make the cosmic version of the nebular theory more widely known in Britain.[111] Nichol's popularisation included Comte's illegitimate attempts to give the theory a better mathematical foundation, a piece of bad logic which, as Schweber has pointed out, went largely unnoticed in Britain.[112] Throughout Nichol's rather florid prose, there were reverent references to the Creator who ordained and sustained the wondrous astronomical order. Amongst all this piety, Nichol did not shrink from criticising Evangelical views about natural theology. He deprecated Chalmers' distinction between the laws and collocations of matter and his insistence that the business of natural theology was only with collocations, or specific arrangements:

> The truth is, a 'collocation' per se excites nothing but wonder, or an unusual commotion in the brain; and this feeling or sensation operates as an incitement and absolute command to the intellect to seek out the physical cause or origin of the new and not comprehended scheme. So far from 'collocations' philosophically considered, being manifestations distinct from laws, they are our first intimations of the road in which we must travel to detect some law hitherto unknown, - they are the first hints which philosophy receives, or which she has ever received, of evils to be encountered and overcome.

Nichol added that the Evangelicals appeared to be glorifying ignorance. According to Chalmers, those parts of Creation of which we knew least gave the most decisive testimony to the existence of a Deity. "It is surely not the supporters of such an affirmation,"

declared Nichol "who ought to scatter lavishly the charge of impiety."[113]

Evidently, Nichol anticipated Evangelical opposition to the nebular hypothesis for its success in explaining the planetary arrangements in terms of the laws of gravitation and motion. In Views of the Architecture of the Heavens (1837), he tried to offer further reassurance to those alarmed by the implications of the new cosmology:

> If uneasy feelings are suggested - and I have heard of such - by the idea of a process which may appear to substitute progress for creation, and place law in the room of providence, their origin lies in the misconception of a name. LAW of itself is no substantive or independent power; no casual influence sprung of blind necessity, which carries on events of its own will and energizes without command. Separated from connexion with an ARRANGER in reference to whose mind alone and as expressive of the Creative Idea it can be connected with the notion of Control - Law is a mere name for a long order - an order unoriginated, unupheld, unsubstantial, whose floor sounds hollow beneath the tread, and whose spaces are all void; an order hanging tremblingly over nothingness, and of which every constituent - every thing and creature fails not to beseech incessantly for a substance and substratum of ONE - WHO LIVETH FOR EVER![114]

Surprisingly, Evangelical criticism was not forthcoming, at least not at first. In 1836, Combe wrote to Nichol:

> I have been much gratified by hearing of your success in Glasgow, and I saw that even the Scottish Guardian was commending you, so that you seem to be approved of by all men, and also by many women.[115]

The following year, Combe welcomed Views of the Architecture of the Heavens as "valuable in a high degree as a means of destroying superstition." Combe linked the nebular hypothesis with the plurality of worlds and that in turn with the implausibility of the Christian doctrine of the atonement:

> ... what force of human testimony is necessary to prove that its Creator assumed the form of a man, and submitted

> to be crucified by barbarian Jews in an obscure corner of an obscure world.[116]

Despite Nichol's links with Combeism, Views of the Architecture of the Heavens was well-received by evangelical reviewers. The United Secession Magazine was exceptional in noticing a lack of Christian theology in the work. The reviewer complained that Nichol had made no mention of the disorder introduced to the world by the entrance of sin. Nor had he discussed the process of Redemption. Apologetically, the critic added that he may have noticed this only because Nichol was a licentiate of the Established Church.[117] Less grudging was the approval of an Evangelical minister of the Established Church, Henry Duncan, who told an audience of Glasgow young men:

> An ingenious and talented townsman of your own [J.P. Nichol] has in his highly popular and interesting work on the 'Architecture of the Heavens', given a graphic account of the progressive operations of creative power, presented, at this moment, to the penetrating eye of the practised enquirer, among those distant nebulae which appear to our unassisted vision, like little specks in the blue vault of the sky. He conjectures, not without the support of astronomical phenomena, that our own solar system as well as the vast assemblage of associated stars which nightly proclaim the glory of the Creator, was once but a diffused and formless expanse of intensely heated ethereal substance, existing through incalculable space, and under the operation of laws impressed upon it by the infinite wisdom of its Creator, converted, through various gradations, into distinct systems of worlds, each performing its destined functions in fulfilling his eternal decrees.[118]

Before Nichol's efforts to popularise the theory, Evangelical attitudes towards it were rather less enthusiastic. In his Bridgewater Treatise, Chalmers, as we have seen in chapter four, had given the nebular speculations of Laplace and Comte a rather cool response.[119] However, if it were accepted, there remained "collocations" in the solar system which could be used to demonstrate

the divine wisdom and power. In 1834, the Presbyterian Review expressed the same qualified approval of the nebular theory. Reviewing Whewell's Bridgewater Treatise, the writer expressed some regret that it had treated so sympathetically the theory of Laplace:

> We are half inclined to regret that it did not fall in with Mr. Whewell's plan to refute this theory in detail. We would have laughed to see the ludicrous figure it would have made, after having been cut up by the hand of such a master.[120]

However the writer conceded that it was perhaps a more prudent strategy to follow the course taken by Whewell. This was to admit the possible truth of the nebular cosmogony, and then to demonstrate that it left the design argument unscathed.

Thomas Dick aided Nichol's efforts to ease concern about the theological implications of the theory. Dick is a fascinating intermediate figure, who seems to have had links with both Evangelicals and Combeists. He sometimes upset his fellow evangelicals by his suggestions that the clergy should deliver scientific discourses to their congregations.[121] Indeed his vision of a future state, in which a regenerated humanity would devote itself to peaceful and rational pursuits, bore a surprising resemblance to the scientific republic of the Combeists. In 1828, Dick had expressed to Combe his hope that a copy of the Essay on the Constitution of Man were "in every house" and "that the truths & Maxims it contains were impressed on every heart, and that Society were constructed and maintained on the principles which it exhibits".[122] Admittedly there were theological difficulties since the Essay appeared to set aside the doctrine of Original Sin but Dick looked to Combe, rather than to clergymen, to resolve them. In 1847, Dick again enthused over Combe's Remarks on National Education and On

the Relation between Religion and Science:

> The train of thought which pervades these tracts corresponds almost entirely with my own. I consider the principles involved in them as of vast importance to the happiness of society, and, I trust, they will be more appreciated by the Public, and particularly by our Rulers, than they have hitherto been.[123]

Smith notes Dick's curious blend of Enlightenment rationalism and evangelical piety.[124]

Dick's works mostly found favour in evangelical circles, both inside and outside the Established Church. In 1834, the United Secession Magazine remarked approvingly:

> It is the tendency of all Dr. Dick's works to correct an evil of long standing; to restore the theology of nature to the attention which is due to it; and to do this in such a way as makes it an ally, and not a rival to the theology of the Bible.[125]

In the Sidereal Heavens (1840), Dick's attitude to the nebular cosmogony was cautious. He pointed out that it was premature to conclude from the apparent linear development, from nebulae through nebulous stars to stars, that this was indeed the manner in which star systems were formed. Nevertheless, he protested the theory's innocence of the charge of infidelity. A divine miracle was needed to furnish each planet with living occupants:

> Nor do we conceive this hypothesis to be inconsistent with what we know of the attributes and operations of the Almighty, for all the movements and changes going on in our terrestrial system and throughout the universe are the effects of certain laws impressed upon matter by the hand of the Creator, by the uniform operation of which his wise and beneficient designs are accomplished. If, then, it forms a part of his designs that new suns and systems shall be formed to diversify the spaces of immensity, and if he has created huge masses of subtle luminous matter, and endued them with certain gravitating powers and rotatory motions for this purpose, his almighty agency, and infinite wisdom may be as clearly and magnificently displayed in this case as if a system of worlds, completely organised, were to start into existence in a moment.[126]

Most interesting of all from the point of view of this study was the strong support the theory received from David Brewster. He had briefly described Herschel's classification of the nebulae as early as 1811, in the chapters he contributed to Ferguson's Astronomy:

> Dr. Herschel considers the phenomena of milky nebulosity as of two kinds, one of which arises from widely extended regions of closely connected clustering stars, like those which form the Milky Way; while the other is real, and possibly at no great distance. The changes which the milky nebulosity of Orion has undergone, both in shape and lustre, seem to indicate that it is not composed of stars.[127]

In his review of Whewell's Bridgewater Treatise, Brewster dismissed the section on the nebular hypothesis as one of the elements ill-fitted for a treatise on natural theology.[128] However, his position had changed drastically by 1838. The occasion for his enthusiastic comments was a review of Comte's Cours de Philosophie Positive for the Edinburgh Review.

Expressing regret that Comte had used the theory to undermine the evidence of design, Brewster did not notice the error in the French writer's reasoning which stripped the natural theologian of rather more of his clothes than was mathematically justifiable. In any case, Brewster remained confident that the design argument was unharmed. The hypothesis was "merely an ingenious speculation", but, even assuming its truth, "the mind still turns itself to the first great cause". Brewster emphasised that such a system required a Creator to give it the right amount of heat and rotatory impulse, adjusting it to the precise velocity that would throw off planets revolving in stable orbits. Significantly too, in view of his later perception of a close link between the nebular theory and the development hypothesis, Brewster saw no danger to natural theological

arguments drawn from the phenomena of life. Even if the planets and satellites had condensed gradually from a gaseous cloud, separate acts of creative power would have been required to provide them with animal life. Above all, he stressed that man had sprung directly from the Divine hand to rule over "this fair empire". Brewster displayed almost unlimited confidence in the flexibility of the design argument. Admitting that Laplace's theory pushed the act of world creation back to an earlier epoch, he made a further concession which he must afterwards have regretted:

> but even if science could go infinitely farther, and trace all the forms of being to their germ in a single atom, and all the varieties of nature to its developement [sic], the human mind would still turn to its resting-point, and worship with deeper admiration before this miracle of consolidated power.[129]

Partly, Brewster's enthusiasm may have sprung from a desire to make capital out of Whewell's alleged timidity in the face of such cosmological theorising. In his Bridgewater Treatise, Whewell had left "to other persons and to future ages to decide upon the scientific merits of the nebular hypothesis". However, he had defended it against charges of fostering atheism using similar arguments to those later employed by Brewster.[130] Unlike Whewell, Brewster was positively enamoured of the cosmic teleology opened up by the theory. In a later article (1844), he referred to "a law of progressive creation, in which revolving matter is distributed into suns and planets".[131] Combining it with a belief in the resisting medium which would eventually destroy the system, Brewster found new moral and theological significance in astronomy. To adapt Hutton's phrase, the star systems displayed both the vestige of a beginning and the prospect of an end. Unfortunately, Brewster's synthesis was

soon to fall apart.

Vestiges of the Natural History of Creation was published anonymously in 1844.[132] It was the work of the Edinburgh publisher and bookseller, Robert Chambers, a phrenologist and a member of Combe's circle. Anxious not to damage his business prospects and public reputation, Chambers took care to keep his identity secret. His work advanced a theory of species transmutation, and some historians, like Lovejoy, have hailed him as a direct forerunner of Darwin.[133] Others have concentrated on the differences between Vestiges and the Origin. Hodge points out that Chambers believed in separate lines of development, whereas Darwin's theory held that all species shared a common ancestry.[134] Chambers' theory was, in fact, very similar to the earlier transmutation ideas of Lamarck, holding progress to be a tendency inherent in living matter. However, Chambers mistakenly attributed to Lamarck the belief that pressure from the environment alone was the cause of species change.[135] Chambers was also able to present the Lamarckian hypothesis in the light of recent evidence from a wide range of scientific disciplines in which he had read voraciously, if not deeply. Some of the evidence was anecdotal and even downright absurd. For instance, in arguing for the relative narrowness of the gap between man and other animals, Chambers credulously reported displays of non-human intelligence, notably a case of dogs alleged to have learned dominoes.[136] However, Chambers drew on several subjects in which orthodox scientists might feel vulnerable: astronomy, palaeontology, embryology and morphology.

It may seem strange that astronomy should find a place in a work dealing with the history of life. However, Chambers' theory of

development was supposed to be universal in its significance, indeed equal in status to the law of gravitation. To emphasise this point, the work began with a chapter on 'The Bodies of Space, their Arrangements and Formation'. Essentially, this was an account of the nebular hypothesis. On the one hand, the development of a sun and planets from a rotating cloud of gas (or "fire mist") was a precursor to the production of life forms, increasing gradually in complexity. On the other, the two processes were directly equivalent, the realisation of one grand principle:

> The masses of space are formed by law; law makes them in due time theatres of existence for plants and animals; sensation, disposition, intellect, are all in like manner developed and sustained in action by law.[137]

Chambers believed that the truth of the nebular hypothesis was virtually proven. Occasional difficulties such as the apparent retrograde motion of the satellites of Uranus could be explained away (in this case in terms of "a bouleversement of the primary").[138]

Chambers' development theory held that life originated in some "germinal vesicle" formed out of inorganic matter and that

> ... the simplest and most primitive type, under a law to which that of like-production is subordinate, gave birth to the type next above it, that this again produced the next higher, and so on to the highest, the stages of advance being in all cases very small - namely, from one species only to another; so that the phenomenon has always been of a simple and modest character.[139]

Two types of evidence were required to establish the truth of this process. The first was proof that there had been a gradual development from simple to more complex species through time. The second was evidence for an underlying mechanism of change. When he turned to palaeontology for help with the former, the progression in the appearance of the vertebrate classes presented Chambers with few

difficulties, since it was widely acknowledged by geologists. However, the transmutation theory required there to be progress within the classes as well. As a result, he was obliged to diverge sharply from advocates of discontinuous progression like Miller in his ranking of creatures as 'high' or 'low'. For instance, Chambers suggested that many of the fossil fish found in the Old Red Sandstone - Cephalaspis, Coccosteus, Pterichthys and Holoptychius - were a connecting link between crustacea and true fish.[140] Miller, as we have seen, considered them to be true fish of an advanced type.

Chambers also drew evidence from morphology, pointing to the existence of rudimentary organs, such as the feet of serpents. He claimed these vestigial forms were most conspicuous in animals which linked different classes, though accepted that the gradation amongst the families of the animal kingdom did not appear to exist "along one line, on which every form of animal life can be, as it were, strung".[141] In arguing for the possibility of change, Chambers relied also on classificatory schemes, particularly that of Macleay, which exhibited the analogies and affinities between different organisms. The regularity of these schemes disproved the 'Lamarckian' doctrine of structural change borne out of the organism's wants and the consequent exercise of its faculties:

> Had such been the case, all would have been irregular, as things arbitrary necessarily are. But, lo, the whole plan of being is as symmetrical as the plan of a house, or the laying out of an old-fashioned garden"[142]

As evidence for the plasticity of species, Vestiges noted the extent to which some species, such as bees, could be modified by the effects of diet and environment. Chambers added some weak evidence that species change was still taking place "in some of the obscurer fields

of creation, or under extraordinary casualties".[143] A report was reproduced that oats sown at the usual time, pruned back during summer and autumn, and left over the winter, yielded a thin crop of rye at the end of the following summer.

To make transmutation plausible, Chambers needed to pursue further his search for an underlying mechanism. Here embryology came to his aid. He used Tiedemann's observations on the foetal progress of the human brain, showing the various stages to correspond to the order of appearance of animal life on earth. Thus, in the first month, the brain had the form of an invertebrate, corresponding with the geological stage up to the Old Red Sandstone. In the second month, it had the form of a fish, corresponding with the first true fish of the Carboniferous formation, and so on.[144] In a chapter on the 'Early History of Mankind', Chambers elaborated on the theory by suggesting that the non-Caucasian races of man showed characteristics of the Caucasian embryo some time before birth.[145] Another approach to the problem of finding a satisfactory mechanism was philosophical rather than scientific. Chambers used the arguments of Babbage's Ninth Bridgewater Treatise in an effort to reconcile uniformity of cause with variety of effect. A fixed law of development could thus give rise to a diversity of species.[146]

There is no evidence that in writing Vestiges Chambers collaborated with other members of Combe's circle. He wrote the book in St. Andrews, away from his Edinburgh colleagues. If Combe's declarations in letters are to be believed, he was not a party to the secret of the authorship, though he must have had his suspicions. However, Chambers was unwilling to confide even in such a close friend. In 1847, he wrote to Combe in some amusement, probably at

the activities of the Association for Opposing Prevalent Errors:

> I have mentioned to one or two geological friends the design of this precious society and they have had a great laugh with me at the idea of coming for a buttress of orthodoxy to Buckland. I believe there is nothing that could be more serviceable to you and the author of the Vestiges [!] than to be assailed by the fraternity in question.[147]

Nichol was neither a collaborator nor a party to the secret, although, like Combe, he was one of the people (other than Chambers) most often suspected of having written the book. Indeed, in 1848, he complained to Combe of the extent to which the unknown author of Vestiges had lifted parts of Nichol's own works.[148] Combe wrote back saying that Chambers had always denied being the author and asking Nichol to refrain from offering him proof of Chambers' involvement:

> I am often asked the question point blank, if he is the author, & I see that the acknowledgement of the book on his part, or the proving of its authorship against him, might be worked by his enemies to his serious disadvantage, & I am, therefore, averse as his friend, to being placed in a situation in which I might be forced to aid them in their sinister designs.[149]

Whatever the exact circumstances of its production, Vestiges clearly owed much to Combe's school. It used phrenological language to discuss the mental capacities of man and animals. The presence of some of the human mental faculties in animals suggested that mental phenomena were essentially the same throughout Creation. Observation of people with congenitally imperfect or diseased brains and of the behaviour of children strengthened the case for continuity. Chambers even suggested that the intellectual faculties, such as causality and comparison, could be present in a rudimentary form amongst the lower animals.[150]

Vestiges also embodied much of Combe's natural theology. If the whole of nature were under the sway of invariant laws, there was an

anomaly in the notion that the Creator had directly intervened not once but several times to populate the Earth (and indeed other planets) with life:

> How can we suppose an immediate exertion of this creative power at one time to produce zoophytes, another time to add a few marine mollusks, another to bring in one or two conchifers, again to produce crustaceous fishes, again perfect fishes, and so on to the end? This would surely be to take a very mean view of the Creative Power - to, in short, anthropomorphize it, or reduce it to some such character as that borne by the ordinary proceedings of mankind.[151]

Nor was human behaviour exempt from the rule of natural law, thanks to the newly developing inquiries into social statistics. Chambers, following the example of Comte, drew attention to the regularities in such occurrences as crimes of drunkenness and even failure to address letters:

> This statistical regularity in moral affairs fully establishes their being under the presidency of law. Man is now seen to be an enigma only as an individual; in the mass he is a mathematical problem. It is hardly necessary to say, much less to argue, that mental action, being proved to be under law, passes at once into the category of natural things.[152]

Like Combe, Chambers grappled with the problem of evil. Although he did not doubt the justice of a system of unvarying natural law, he was less confident than Combe that such a system invariably operated to the advantage of particular individuals, even in a reformed society of the future:

> It is clear, moreover, from the whole scope of the natural laws, that the individual, as far as the present sphere of being is concerned, is to the Author of Nature a consideration of inferior moment. Everywhere we see the arrangements for the species perfect; the individual is left, as it were, to take his chance amidst the melee of the various laws affecting him. If he be found inferiorly endowed, or ill befalls him, there was at least no partiality against him. The system has the fairness of a lottery, in which everyone has the like chance of drawing the prize.[153]

Nevertheless, Chambers emphasised that these qualifications were not intended to instil a spirit of resignation or fatalism. He remarked that few evils were altogether unmixed; there was often a compensating principle at work. For instance, blind people acquired an acute sense of touch, whilst persons born without hands might develop an extraordinary facility for using their feet instead. Chambers' deism was also evident in his frequent use of expressions like the "Almighty Deviser", the "Divine Author", the "Great Father" and the "Great Ruler of Nature".[154] Like Combe, he quoted orthodox natural theologians in his support. Buckland was invoked in favour of the idea that 'development' was not atheistic:

> If the properties adopted by the elements at the moment of their creation, adapted them beforehand to the infinity of complicated useful purposes, which they have already answered, and may have still further to answer, under many dispensations of the material world, such an aboriginal constitution, so far from superseding an intelligent agent, would only exalt our conceptions of the consummate skill and power, that could comprehend such an infinity of future uses under future systems, in the original groundwork of his creation.[155]

Buckland's words had actually been concerned with the development of physical nature but, interestingly, he did not remove them from editions of his Bridgewater Treatise published after Vestiges.

De Giustino notes that continental phrenologists produced a number of evolutionary works.[156] Although British phrenologists were cautious in entering this territory, some members of Combe's circle had made preliminary sorties. The clearest anticipation of Chambers was by the botanist, Hewett Cottrell Watson, in his reply to William Scott's Harmony of Phrenology with Scripture. Among the points in Scott's book challenged by Watson was the assertion that species were fixed and incapable of improvement, and that therefore nature did not

contain within itself "the elements of improvement". Watson stopped short of putting forward a fully-developed transmutation theory but emphasised the extent to which species could be changed by the breeding activities of man. For instance, the domestic dog now existed in a remarkable variety of forms, and it was not possible to point to a wild animal from which it had descended. This suggested that a species change might have occurred. Watson also stressed the fragmentary nature of the fossil record, and the remote connection which existed between a fossil and the original animal which had given rise to it.[157]

Although Nichol seems to have been less happy than other Combeists about Vestiges, the links between his work and Vestiges were not entirely of Chambers' own forging. As Nichol himself admitted in 1859, commenting on speculations at the time of the book's first appearance that he was its author, "lectures of mine, and frank, unrestrained conversation of mine, gave certain justification to that conjecture".[158] In the Westminster Review article, he referred to Sir John Herschel's claim that, even if every single link in the chain of nebular types were known to exist, this in itself would not establish the fact of a development through time. Herschel had made an analogy with the possibility of a chain of being in biology, stressing that such a chain, even if continuous, would not prove that one species could change into another. Nichol felt that the analogy was not perfect because in the case of the nebulae there was a known underlying mechanism which could bring about the changes. However he added that, even in the case of living forms, a transition process could not be ruled out:

> The 'intranspossibility' [sic] of what are termed the

> 'limits of species', is by no means settled; and it seems that the holders of the dogmatic belief to this effect rest their chief authority on the power to ridicule Lamarck, who grasped at a philosophical conception before he knew of any facts by which it could well be illustrated. Zoology is too much in its infancy - too much a mere science of classification on the ground of observed differences - to permit of dogmatism on either side of this question; but unquestionably, when Lamarck asserted, in the face of much obloquy, that a 'transpossibility' and a progression might exist, he was far nearer the truth than his noisy opponents.[159]

It is less clear that the recurring biological metaphors in Views of the Architecture of the Heavens actually implied his acceptance of the transmutation theory, although with hindsight it was certainly possible to read them in this way. For instance, the following passage may have suggested to Chambers the idea of a general principle of development, embracing both inorganic and organic nature:

> ... within that looming mass, whatever be its final destiny, there are doubtless wide and systematic relationships, - each particle of its matter will be arranged and adjusted to its neighbour; nay, who can tell, who that has looked on those monuments of bygone worlds - the fossil relics which mark the early progress of our own planet - but, this amorphous substance may bear within it, laid up in its dark bosom - the germs, the elements of that LIFE, which in coming ages will bud and blossom, and effloresce, into manifold and growing forms, until it becomes fit harbourage and nourishment to every varying degree of intelligence, and every shade of moral sensibility and greatness.[160]

Vestiges incurred practically the united wrath of the scientific elite. Adam Sedgwick, Sir John Herschel, Charles Lyell and David Brewster had nothing good to say abut it. Even T.H. Huxley, later to be one of Darwin's keenest supporters, described his irritation at what he called "the prodigious ignorance and thoroughly unscientifc habit of mind manifested by the writer".[161] Although Huxley was mainly upset by its mistakes and general lack of scientific rigour

many critics, such as Sedgwick, were deeply alarmed by its implications for natural theology and for the status of man. In a lengthy catalogue of its errors in the Edinburgh Review, the Cambridge geologist found it "not merely shallow and superficial, but utterly false throughout to all the principles of sound philosophy".[162] He continued to attack the book for several years afterwards, the large sales of Vestiges no doubt proving an additional irritant.

The Scottish Evangelicals were not slow to respond to its poisonous doctrine. Fleming considered it to be "the production of a visionary, and ... full of the grossest materialism."[163] Brewster found it "prophetic of infidel times, and indicating the unsoundness of our general education".[164] Speculation abounded as to the author's identity. At various times, a finger of suspicion pointed to Lyell, Owen, Harriet Martineau, Sir Richard Vyvyan, M.P. and even Prince Albert.[165] In Scotland, many critics came closer to the truth. J.D. Forbes confided to Whewell in 1846 that the author was "now generally believed to be a denizen of Modern Athens".[166] In 1847, Macphail's Edinburgh Ecclesiastical Journal printed parts of Chambers' Information for the People side by side with similar passages from Vestiges, leaving readers to draw their own conclusions.[167] In 1848, suspicion was great enough for Chambers to feel obliged to withdraw as a candidate for Lord Provost of Edinburgh.[168] Combe was also a prime suspect, either as author or collaborator. From 1860 (and possibly earlier) until at least 1877 the British Museum Catalogue listed him as author.[169]

The Free Church scientists were quick to recognise the provenance of the work, if not the author's exact identity. "He is

an avowed phrenologist", declared Brewster "and so we have no fear of being foiled by his dialectics."[170] Even more precisely, Miller observed:

> There is a school of infidelity, tolerably well known in the capital of Scotland as by far the most superficial which our country has yet seen, that measures mind with a tape-line and the callipers, and, albeit not Christian, laudably exemplifies, in a loudly expressed regard for science, the Christian grace of loving its enemy. And the belief in a special Providence, who watches over and orders all things, and without whose permission there falleth not even a "sparrow to the ground", the apostles of this school set wholly aside, substituting, instead, a belief in the indiscriminating operation of natural laws; as if, with the broad fact before them that even man can work out his will merely by knowing and directing these laws, the God by whom they were instituted should lack either the power or the wisdom to make them the pliant ministers of his. It is, I fear, to the distinctive tenet in the creed of this hapless school that the author of the "Vestiges" refers.[171]

The appearance of Vestiges helped to convince the Free Church of the need for a chair of natural science at New College.[172] Fleming, who was appointed the following year, did not produce a detailed refutation of Vestiges although his course included a review of "opinions respecting Progressive Development, and the transmutation of species."[173] In his introductory lecture (1850) he condemned the "crude generalizations from imperfect or misunderstood data" contained in Vestiges. They were likely to foster "errors of a very dangerous kind".[174] He also atacked his former Wernerian ally, Robert Jameson, for the favourable reception he had given to Vestiges and to its sequel, Explanations, in the Edinburgh New Philosophical Journal.[175] Brewster first, and then Miller, produced detailed replies to Chambers' work. Like other critics of Vestiges, Brewster condemned its materialistic view of the brain and behaviour. Like other critics, he ridiculed Chambers' acceptance of such discredited discoveries as those of Crosse and Weekes, who believed that they had

produced a kind of insect by the action of electricity. The high rank of the Old Red Sandstone fish, the advanced plant life of the coal measures and the existence of representatives of the highest order of reptiles in the Permian formation were among evidence from palaeontology which Brewster marshalled against the theory. However, his greatest blow to Vestiges was his assault on the nebular hypothesis. Chambers had given the theory great prominence by putting it in the first chapter. The bait was too tempting for Brewster. He proclaimed that he would demolish not only the transmutation theory but also the nebular hypothesis on which it "rests its foundation."[176]

Unfortunately for Chambers, the nebular theory encountered difficulties the year Vestiges was published. Thanks to telescopes superior to those of Herschel, the astronomer Lord Rosse succeeded in resolving a number of nebulae previously thought to be irresolvable. His discoveries initially served to weaken the foundations of the nebular hypothesis without destroying them. Rosse himself, in his paper of 1844, emphasised that it was "very unsafe.. to draw the obvious inference that all nebulosity is but the glare of stars too remote to be separated by the utmost power of our instruments".[177] Interestingly, many opponents of Vestiges shared his reluctance to abandon faith in 'true nebulosity'. In his Edinburgh Review article (1845), Sedgwick drew attention to some of the problems which the theory brought with it, such as its failure to explain the motion of comets and the retrograde motion of the satellites of Uranus. He also pointed out that should all the nebulae be resolved into stars "then all the conditions of equilibrium are changed, and there is, at once, an end of the nebular hypothesis". But he added: "we have

better hopes for the coming fortunes of this splendid vision".[178] William Henry Smith, also writing for a Scottish periodical, declared:

> The nebular hypothesis, though not yet entitled, as we think, to be considered, other than an hypothesis, has assumed a shape and consistency which forbids an entire rejection of it, which enforces our respect, and which, at all events, habituates the imagination to regard our planetary system as having probably been evolved, under the will of Providence, by the long operation of the established laws of matter.

Indeed, Smith thought it was perhaps more derogatory to "our notions of the Supreme" to speak of God "launching" the planets into space than to adopt the nebular cosmogony.[179] Although Chambers put forward a similar natural theological argument against the origin of species by individual acts of creation, Smith went on to attack the hypothesis of species transmutation.

Even after the nebular theory had been seriously weakened by Rosse's discoveries, many of its erstwhile supporters in Scotland showed a hankering after it. The Rev. George Gilfillan, a minister of the United Presbyterian Church, but something of a theological renegade, wrote that he relinquished the hypothesis "with a sigh". Indeed:

> ... although that hypothesis is now commonly thought exploded, it is only so far as the visible evidence is concerned - as a probable and beautiful explanation of phenomena, the origin of which is lost in the darkness of immeasurable antiquity, it retains its value.[180]

As late as 1850, a writer in Macphail's Edinburgh Ecclesiastical Journal thought it was "impossible to explore the depths of space and survey these strange forms, without feeling the conviction that there is some development - that they are moving onwards to some higher destiny."[181] Similarly, Thomas Dick, although inclined to drop the

theory in the 1846 edition of the Christian Philosopher,[182] had by 1850 regained some of his earlier enthusiasm. He remarked that Rosse's discoveries only reduced the number of "those bodies which are to be reckoned as pure nebulae, or chaotic matter". Therefore "we are not to imagine that, in consequence of these discoveries, the nebular theory is completely overturned."[183] Since these writers rejected species transmutation, it is clear that enthusiasm for the nebular theory did not necessarily imply approval for Chambers' use of it.

The response of Free Church reviewers was different. Brewster noted that Laplace and Comte had adopted the nebular theory to explain the origin of our own solar system but stressed that this was before Rosse's discoveries had disproved the existence of nebulous matter:

> But if these are M. Comte's views, upon the supposition that the existence of nebulous matter different from stars is fact, what will be his opinion of such speculations when that fact is disproved, and the very foundation of this class of hypothesis taken away?[184]

In a further effort to give some appearance of continuity with his earlier views, Brewster made a distinction between the theory of Chambers and that of Laplace, claiming it was only Chambers' theory he was attacking. For instance, Chambers did not explain the rotatory motion of the nebulous mass, whereas Laplace had supposed the Creator was required to set it rotating in the beginning. This is a surprising distinction since Chambers referred this rotation to "a well-known law in physics".[185] Vestiges emphasised that laws of nature had been ordained by the Creator. By contrast, Laplace and Comte were usually understood to have employed the nebular hypothesis as a means of dispensing with the need for a Creator.[186] Brewster

also accused Chambers of failing to explain the cooling of the gaseous body. Moreover, "in the crude sun-making under our review, no contrivance exists for providing light and heat as the emanations from the central mass". Once again he exonerated Laplace, imputing to him a remarkable measure of orthodoxy. According to Brewster, he had adopted the Mosaic cosmogony and referred the origin of light to God's creative fiat. Brewster asked why, if heat necessarily resided in the central mass, suns were the only luminous bodies, why not the planets and satellites as well? Although an arch-opponent of the undulatory theory of light, he even asked how the nebular theory accounted for the origin of the luminiferous ether!

One difficulty was heaped upon another: the motion of comets, the motion of the solar system through space, and as a final blow, Lord Rosse's resolution of distant nebulae. Even before Rosse's discoveries, Brewster claimed that the arguments for 'true nebulosity' were slight:

> Many nebulae are uniformly luminous, as if they were flat discs: others have their light unequally distributed, while vast numbers have the most irregular shapes, indicating no appearance of rotation, and no appearance of a central accumulation. Independently, therefore, of the discoveries of Lord Rosse, there was every reason to believe, from analogy as well as from observation, that nebulae are mere collections of stars, deriving their general lustre, or the lustre of their individual parts, from the brightness and the number of the stars of which they are composed, and often exhibiting the appearances of globes or discs, from the inability of our telescopes to detect their ramifications and appendages.

Despite his insistence that it was the theory advanced by the author of Vestiges that he was refuting, it is clear that his strictures applied equally to the nebular speculations of Laplace and Herschel. As a final blow to a hypothesis "so improbable in its very nature, and so gratuitous in all its assumptions", Brewster calculated the

original density of the nebulous matter supposed to have formed the solar system. Since the matter must originally have filled a sphere the radius of the orbit of Uranus (the remotest known planet of the time) its density must have been "many millions of times rarer than the rarest of our gaseous bodies!"[187] Brewster believed that such a sphere could not revolve as a connected mass.

None of these arguments was appealed to before 1845, yet all except Rosse's discoveries were available long before Vestiges was published. Interestingly, it can be shown that Vestiges, rather than Rosse's discoveries themselves, brought about Brewster's dramatic about-face. The reason we can be fairly certain about this is that Brewster wrote an article about these very discoveries in which he continued to advocate the nebular theory. The article was published in the North British Review for November 1844, a month after Vestiges was published, but Brewster's undiminished enthusiasm for the nebular theory suggests he was not yet aware of its pernicious misuse by Chambers.

In the 1844 article, Brewster noted that Lord Rosse had resolved five nebulae in Sir John Herschel's catalogue. The discoveries had destroyed "that symmetry of form in globular nebulae" upon which the hypothesis of gradual condensation was based.[188] Brewster's faith remained unshaken. He still believed that the distant heavens could yield information about the history of our own system:

> Placed upon a globe already formed, and constituting part of a system already complete, he can scarcely trace either in the solid masses around him, or in the forms and movements of the planets, any of those secondary causes by which these bodies have been shaped and launched on their journey. But in the distant heavens, where creation seems to be ever active, where vast distance gives us the vision of huge magnitude, and where extended operations are actually going on, we may study the cosmogony of our own

> system, and mark, even during the brief span of human life, the formation of a planet in the consolidation of the nebulous mass which surrounds it.[189]

The next review in which Brewster discussed the nebular speculations was his review of Vestiges. Here, as we have seen, there was a dramatic change of view. Hiding behind the anonymity of the reviewer, Brewster did not acknowledge the change. Instead, Chambers was credited with more originality for his world-forming theory than he really deserved, and the hypothesis was then loaded with objections. Conversely, Brewster attributed to Laplace theological defences for his nebular thory which more properly had belonged to Scottish Evangelical writers such as Chalmers and Brewster himself.

In 1846, Brewster was to admit that he had once advocated the nebular theory, confessing the reason for his change of mind:

> Captain Smith, as most of us had previously done, till they became the basis of mischievous speculation, has adopted all the extravagant ideas about nebulous matter and its condensation into stars; but while he styles the nebulae "chaotic rudiments under active arrangement, advancing towards organization and beauty", he neutralizes this opinion by the confession "that nature has yet to be caught in the fact of condensing the phosphorescent or self-luminous matter diffused through certain regions of space into future systems, according to the plausible speculations of Sir W. Herschel.[190]

Other Free Church writers followed Brewster's example, although no one else's opinions can be shown to have undergone such a dramatic change. However, Hugh Miller, as editor of the Witness must either have written or at least given his blessing to the following item which appeared in the newspaper as late as July 1845 in a review of the fifth edition of Nichol's Architecture of the Heavens:

> And hence it has been somewhat hastily inferred that all the nebulae may, like these, be yet resolved into stars,

> and that thus the nebular theory may fall, from lack of nebular matter on which to give it footing, or out of which to construct it. The inference is decidedly premature; and we find the reasons that prove it to be so, admirably given in a preface attached by Dr. Nichol to this new edition of his work.[191]

The review made no mention of Vestiges and it seems reasonable to assume that Miller was not yet aware of the theory's changed significance. The passage is in marked contrast to an undated (but presumably later) letter that Miller wrote to the mineralogist, Alexander Rose:

> How, I marvel, are the Astronomical Geologists to get on without their nebula matter. It will be a tremendous downfall if, like mere vulgar Christians, - people like you & I, - they have to believe in Creation after all. It was of course High Science to hold that Worlds were formed out of fire-mist; but it will be mere Theology to hold that they have been created out of nothing.[192]

John Fleming's early views on the nebular hypothesis are not known. However, after Vestiges he lumped together the two theories: nebular and transmutation. Fleming wittily associated the "fire-mist" of the nebular cosmogony with the "fog" of ignorance and confusion which enveloped gullible readers of Vestiges:

> They acknowledge their dependence on the premises which he has advanced, but of the mixed character of the premises themselves they have no distinct conception; ... so that in company with the author they become surrounded with a nebulosity which all the resources of their science are incapable of resolving.[193]

Brewster continued to attack the nebular theory with all the zeal of a convert recoiling in horror from past heresy. Lord Rosse's discovery of the spiral structure of some nebulae made Brewster fear that the hypothesis could return to favour. In 1854, he warned readers of the North British Review:

> Lord Rosse, the actual discoverer of these spiral nebulae, has never ventured an explanation of their origin. It is

> the idle and presumptuous speculator only who must find a secondary cause for every wonder in creation;[194]

He also maintained that some nebulae might not be resolved even by "telescopes of infinite perfection and infinite power", because of the refractive effect of the earth's atmosphere.[195] This neutralised the value of unresolved nebulae as counter-evidence to the belief that all nebulae were star-clusters. To such an extent did Brewster conflate the nebular and development theories that he hailed Darwin's theory of evolution as the "more offensive offspring" of the nebular theory, "the great parent heresy".[196]

As I have already indicated, support for the nebular hypothesis declined in the late 1840s under the impact of Rosse's discoveries. Schweber has pointed out that Sir John Herschel's presidential address to the British Association meeting in Cambridge in June 1845 was influential in discrediting Comte's version of the theory.[197] It also encouraged a much more critical examination of the evidence for all such cosmogonical hypotheses. Nevertheless, the Evangelicals, especially Brewster, were exceptional for the speed at which they travelled from advocacy to opposition. As we have seen, certain opponents of Vestiges abandoned the nebular hypothesis only with reluctance. Some criticised Brewster's reason for dropping it so hastily. Such critics were at pains to emphasise that they had given up the theory because it had been losing observational support, and not because of its forced marriage with the hypothesis of species transmutation. As Macphail's Edinburgh Ecclesiastical Journal pointed out, Chambers had not been the first person to use the nebular hypothesis in support of "godless materialism". Assigning to the author of Vestiges a truer measure of originality, the writer

pointed out that Laplace had also used the theory in order to expel God from His Creation. The French philosopher had employed the theory of gravitation for the same purpose. Would Brewster abandon that too? While admitting that the nebular theory had been losing weight "on purely scientific grounds", the writer objected to the view that it had become tainted by association with Vestiges.[198] .

It was not only in astronomy where Brewster expressed an increased aversion to the operation of 'natural law'. In a review (1854) of Murchison's Siluria, he insisted that the geologist must "deal tenderly with popular feeling by refraining from those wild hypotheses in which the powers of omnipotence are limited to secondary causes, and periods of almost infinite length demanded for operations which from physical laws, of which we are ignorant, may be more summarily completed."[199] Even miracles could not be ruled out:

> Under the influence of electric agency, and chemical and physical forces of higher activity, even secondary causes may have operated much more quickly than at present; but as creative power must have, at some period, acted by its might fiat, and actually did, even in the opinion of geologists themselves, by the direct creation of new life, after all pre-existing life had been destroyed, why should the same power be limited in its exercise, and myriads and myriads of years demanded for the preparation of a home for man?[200]

As we saw in chapter five, some of Brewster's anxiety about the length of the geological time scale sprang not from Vestiges but from William Whewell's Essay on the plurality of worlds (1853). However, it is wrong to put all of the blame on Whewell and none of it on Chambers. After Vestiges, other Evangelical writers showed an increasing anxiety about containing the advance of 'natural law'. Miller perhaps saw the issues more clearly than Brewster. He recognised that there was no "positive atheism" involved in the

belief in the development hypothesis:

> God might as certainly have originated the species by a law of development, as he maintains it by a law of development; - the existence of a First Great Cause is as perfectly compatible with the one scheme as with the other: and it may be necessary thus broadly to state the fact, not only in justice to the Lamarckians, but also fairly to warn their non-geological opponents, that in this contest the old anti-atheistic arguments, whether founded on the evidence of design or on the preliminary doctrine of final causes, cannot be brought to bear.[201]

For Miller, the real challenges posed by Vestiges were to the status of man as an immortal and responsible being and to the Christian scheme of redemption:

> Dissociated from these beliefs, a belief in the existence of God is of as little ethical value as a belief in the existence of the great sea-serpent.[202]

Natural laws which reduced man to a mere animal were clearly unacceptable but Miller, like Brewster, seems to have become uneasy about submitting other parts of nature to the reign of invariant law. Could one now be content with the voluntarist theology, which held that the Creator was active whether he sustained or suspended the laws of nature? Miller seems to have had doubts. Another way of admitting Providence into the natural order was by treating laws of nature as mere statistical regularities, which could be overturned without warning. During the 1849 cholera epidemic, the Witness used this argument to defend the efficacy of prayer:

> What we term our fixed causes resemble at best but the fixed revolutions and certain operations of a machine in motion. We may calculate from observation on the force of these in a given direction, or their number in a given time, while we are altogether ignorant of the period when the steam or the water may be turned off, and the whole reduced to inaction and silence.[203]

Similarly, in geological history, Miller showed a greater willingness to countenance cataclysms and instability. It is interesting to note

the change in his interpretation of the manner of death of some fossil fish in the Lower Old Red Sandstone. In the Old Red Sandstone (1841), he commented on one particular platform found in Orkney and Cromarty where the remains "exhibit unequivocally the marks of violent deaths", but added that the catastrophe must have taken place "in a sea unusually still", from the fishes' remarkable state of preservation. Speculating on possible causes, Miller suggested that a sudden outbreak of disease, or possibly the action of lime from a distant volcano might have led to their deaths.[204] The Sketch-book of Popular Geology (1859) remarked that there were several such platforms of sudden death, adducing them as evidence that

> ... the sea in these early times was not less subject to disastrous catastrophe than the land, - that that order of nature which we now term its fixed order, on whose permanency our minds have been framed to calculate, was, if I may venture the expression, enacted, but not enforced, and so the breaches of it were scarce more exceptional than the observance, - that life, greatly more emphatically than now, was the least certain of all things, - and that both in sea and on the land the young and immature earth, like an inexperienced and careless nurse, was ever and anon overlaying and smothering its offspring.[205]

By 1857, John Duns was advocating geological catastrophism of the most extreme kind. Major physical changes required divine intervention:

> We wish it were possible to destroy this distrust of the simple acknowledgement of the probable presence of miracle in the different stages of the building up of the world, which obtains so largely in our own day. It would keep us from the unsafe tendency into which many theologians have recently fallen, of trying to commend the works and ways of God, by robbing them as much as possible of what is miraculous. But truth suffers.[206]

In Miller's case, the publication of Vestiges contributed to his change in interpretation, although the accumulation of evidence for such violent death must also be taken into account. Moreover,

Miller's views of geological dynamics had matured during this period. In Footprints of the Creator (1849), written in reply to Vestiges, there was a stronger emphasis on the progression in the earth's physical history. The fish or reptile would be fitting occupants of "a partially consolidated planet, tempested by frequent earthquakes". Even their violent deaths would not be accompanied by great suffering. Higher forms of life, and especially man, would have been wholly unsuited to such a precarious existence. Their time came much later:

> That prolonged ages of these tempests did exist, and that they gradually settled down, until the state of things became at length comparatively fixed and stable, few geologists will be disposed to deny.[207]

In the Sketch-book of Popular Geology, Miller took issue with both Lyell and Nichol for their assertion that igneous activity in the earth's crust could be accounted for without resort to the notion of central heat. Nichol had suggested that the globe might be solid all the way through "and assuredly a distinct negative is given to a whole class of prevalent geological conceptions, on grounds vastly more solid than any which appear to sustain them."[208] Lyell argued that chemical processes involving the oxidation of metals could produce sufficient amounts of heat to dispense with the need for the earth's core to be in an incandescent state.[209] Miller believed that the oblate spheroid form of the earth could not have been produced if the globe had been in a solid state. He agreed "with Humboldt, and with Hutton, with Playfair and with [Sir James] Hall, that this solid earth was at one time, from the centre to the circumference, a mass of molten matter."[210] In Footprints, Miller remarked:

> It is in the style and character of the dwelling-place that gradual improvement seems to have taken place, - not in the

functions or the rank of any class of its inhabitants;[211]

This might be taken as a sign that Vestiges had frightened Miller away from his earlier adherence to the transcendental progressionism of Agassiz. However, while appearing to throw in his lot with the physical progressionists, Miller did not renounce the doctrines of the transcendental school. He reproduced the observation of the foetal progress of the human brain, aware that upon its truth "the assertors of the development hypothesis have founded so much." Miller shrewdly remarked:

> We are perhaps too much in the habit of setting aside real facts, when they have been first seized upon by the infidel, and appropriated to the purposes of unbelief, as if they had suffered contamination in his hands.

Re-interpreted correctly, the doctrine of recapitulation revealed the human brain to be "an epitome of geologic history ... a compendium of all animated nature, and of kin to every creature that lives."[212] Miller's progressionist view of the history of life had been modified but not abandoned. The fossil evidence no longer indicated that the mollusc and the crustacean preceded the fish. However, fish had almost certainly preceded reptiles and birds, which in turn had preceded mammiferous quadrupeds. Man had appeared last.[213]

Clearly, care is required in assigning palaeontologists either to a "physical" or to a "transcendental" school. Miller's mature view seems to have combined elements of both. The preparation of the earth as a home for man and the successive appearance of vertebrate classes were processes charged with theological significance. Miller's age theory for the Mosaic days suggested that God was now resting from his creative labours: "the work of REDEMPTION may be the work of his Sabbath day."[214] The final element in Miller's drama of

theological geology was the theory of degradation. This can be seen as an elaboration, in response to Vestiges, of his earlier theory of discontinuous progress. Since he had always denied that there was progress within classes, it was quite a short step from here to the view that there had been degradation within classes.

Miller's early work had been concerned with the fossil fish of the Old Red Sandstone (or Devonian) system. In Footprints of the Creator he ranged more widely, though the book's subtitle, The Asterolepis of Stromness, referred to a highly-developed fish of the Old Red Sandstone. Miller's degradation theory was based upon the form of the skeleton. Degradation could occur as missing parts, such as limbs, or as redundancy. For example, the serpent lacked limbs but overcompensated by "a vegetative repetition of vertebra and ribs".[215] It could also take the form of displaced parts. In all symmetrical animals of the first three classes of vertebrata (mammals, birds and undegraded reptiles), the limbs marked the three great divisions of the vertebral column: the neck, the trunk and the tail. This structure was found in the fish of the Silurian system, the positions of the double fins corresponding to the positions of their homologues - the limbs - in symmetrical mammals, birds and reptiles. Only in the fish of the Old Red Sandstone did the palaeontologist first encounter displacement of parts. In nearly all the ganoids of the period, the structure resembled that of a human without a neck, the equivalent of the 'arms' being stuck on to the back of the head. There also appeared to be examples of Old Red fish with missing limbs: hind in the case of Pterichthys, fore in the case of Coccosteus.

In the Cretaceous period, fish appeared with all four 'limbs'

crowded into the place of the extinguished neck: "And such, at the present day, is the prevalent type among fishes".[216] The appearance of fish in which the skeleton was asymmetrical, the creature being half twisted round and laid on its side, as in the flounder, plaice and turbot, represented a further stage of deterioration. The tail also underwent changes. The heterocercal or one-sided tail of the Silurian fish was homologous with the tails of the higher vertebrata. The first appearance of displaced limbs in the Old Red period corresponded with the beginning of a transition in the tail from the heterocercal to the homocercal type. This homocercal tail was "without homologue in the higher animals."[217]

On the structure of the fish, Miller admitted that he was at odds with Owen and other comparative anatomists, who regarded the attachment of the scapular arch and the fore-limbs to the occipital bone, not as a displacement, but as the normal state of the skeleton.[218] In reply, Miller seemed to render the degradation theory circular. It was not surprising that anatomists and geologists should disagree, because they had different concerns. While anatomists were concerned with structure and symmetry, geologists were concerned with time. What the anatomist regarded as primary and original, the geologist held to be secondary because of its later appearance in time.

Miller saw in the degradation theory a metaphor for the future destiny of Man. The introduction of a higher class of vertebrates corresponded to the elevation of the saved; the appearance of degraded races <u>after</u> the most noble forms of the class was the counterpart of the damnation of the wicked. It evidently gave Miller especial satisfaction to point out that "the footless serpent", long

held by theologians to belong to "an order of hopelessly degraded beings" had been a latecomer amongst the reptiles. The theory suggested a radical departure from the unblemished world of eighteenth century natural theologians like Paley. Miller consigned parts of creation to the condition of "squalid savages and degraded boschmen". Although he emphasised that "all animals be fitted by nature for the life which their instincts teach them to pursue" he considered that, for example, the poison-bag of snakes was "a protective provision of a low character, exemplified chiefly in the invertebrate families".[219]

As a kind of argument ad hominem in response to Chambers, Miller commented that it would be as easy for "an ingenious theorist" to invent a theory of degradation as to produce evidence for a development hypothesis. He was at pains to emphasise that he did not believe degradation to be a natural process. Defects resulting from accidents were not generally transmitted to offspring. In any case they were insufficient to overcome "that infinitely stronger antagonist law of reproduction and restoration which, by ever gravitating towards the original type, preserves the integrity of races".[220] Miller was thus careful to make sure that transmutation did not slip in by the back door as a direct result of his efforts to close the front. Some of his fellow writers were less skilful in guarding all the entrances. A reviewer in the Free Church Magazine referred to "successive stages of creative advancement at the command of God, and decay under the law of degradation".[221]

Even before Vestiges, Sedgwick was, like Miller, a determined upholder of the discontinuous nature of the fossil record. Indeed, he was unhappy about the transcendental progressionism of Agassiz.[222]

Whilst Vestiges led him to reiterate and expand upon the evidence for discontinuous progression, Sedgwick did not use Miller's theological framework. Miller's theology of degradation seems to have been a response peculiar to the Scottish Evangelicals; other geologists were, nevertheless, delighted with the power of Miller's invective against Chambers. Buckland used Footprints in his Oxford lectures.[223] Murchison praised the book for the "infinite service" it would render "in scaring away that nightmare the Vestiges".[224] Owen thought Miller had done his work well, finding Footprints "not so hard and indigestible as it may prove to the 'Vestigians'."[225] In the North British Review (1850) Brewster eagerly disseminated the main elements of Miller's counter-blast to Vestiges, including the degradation theory.[226] As with his speculations about a plurality of worlds, there was a strongly individualistic streak in Brewster's discussions of progression and degradation. In his review of Vestiges, he offered an uncharacteristic measure of social pessimism as proof of non-progression: "no such amelioration has shown itself in our moral being."[227] However, he subsequently qualified this with a theory of social progress which was essentially 'catastrophist'. Progress in human society was won at the expense of great upheavals, periods of fear, confusion and even bloodshed. In geological history, similarly, successive creations had been destroyed by "the volcano, the earthquake, and the flood" as the earth had been "prepared for the residence of man, and the rich materials in its bosom elaborated for his use, and thrown within his grasp."[228]

Brewster's suggestion that there had been pre-Adamite races of men contradicted the view held by Miller, Buckland and other orthodox scientists that man's history fell entirely within the Biblical

chronology. Brewster thought that men might have existed in earlier geological epochs but not have left fossil remains. There might even have been creations predating the azoic formations:

> Another creation may lie beneath - more glorious creatures may be entombed there. The mortal coils of beings more lovely, more pure, more divine than man, may yet read to us the unexpected lesson that we have not been the first, and may not be the last of the intellectual race.[229]

Brewster later used this notion as another means of combating Whewell's argument against a plurality of worlds. Instead of shortening the geological time scale, one could increase the portion of it during which men, or other intelligent creatures, had existed.[230] However, the theory also bore some resemblance to Miller's biological version of the fall. Brewster even endeavoured to collect evidence for the belief, putting forward a paper to the Aberdeen (1859) meeting of the British Association on a nail that had apparently been found in the Old Red Sandstone of Kingoodie, near Dundee.[231] After Vestiges, Brewster also inclined towards the view that palaeontologists had not yet penetrated to the beginning of the history of non-human life. In his review of Murchison's Siluria (1854), he suggested that fossil fish might yet be discovered in the lower Silurian, or even in an earlier formation.[232]

Where Vestiges encountered criticism from Combeists it was over technical details rather than over its general principles. Thus the Scotsman, though not entirely convinced of the theory's scientific cogency, considered the author to be

> ... no surly or discontented infidel, but one, be his views right or wrong, who has the highest notions of the Deity, who looks with hope upon the fortunes allotted for his species, and would improve them as far as he can.[233]

In 1844, Combe confessed that he found defective the evidence

assembled by Chambers for the claim that living forms had developed out of unorganised matter. He acknowledged, however, that the work possessed "all the sublimity of a grand poem, and the sober earnestness and perspicuity of a rigidly philosophical induction."[234] Despite his later denials, in letters to the Rev. C.J. Kennedy, that he had ever subscribed to the development theory,[235] he mentioned Chambers' work sympathetically in later editions of the Constitution of Man. Chambers had earlier defended Combe's work. Combe now reciprocated with a statement that Vestiges was innocent of charges of tending to atheism.[236]

Nichol was less favourably disposed to Vestiges. He continued to uphold the nebular hypothesis until 1846. In that year, the apparent resolution of the nebula in the Orion constellation, which he had previously accepted would be a kind of experimentum crucis, made him abandon the theory. Despite a rather bald letter to the editor of the Scottish Guardian declaring that the nebular hypothesis was "no longer tenable", it appears that he did not give up the more limited version, which, following Laplace, applied only to our own solar system.[237] Indeed, he was still putting forward the Laplacian theory as late as 1857.[238] Interestingly, after the overthrow of the earlier hypothesis, Nichol adopted a quite different view of the development of star systems. He revived an early theory of William Herschel's which maintained that the underlying process was one of clustering and compression. According to Nichol, this idea had been corrupted by Herschel's later theorising:

> ... if his conceptions on this subject had not been much modified by his hypothesis regarding the diffusion and aspects of the nebulous fluid, he would have traced it through many subsequent degrees, - even to the phenomenon of a nebulous star, involving a closeness or crowding of

> central masses nowhere else represented, and therefore almost inconceivable.[239]

The process was different, but the language in which Nichol described it was similar to that of his earlier accounts of the nebular theory. Organic metaphors abounded; decay, death and cyclical processes were reconciled with the notion of progress:

> ... those august and glorious forms are ever passing away - it may be, as the blossom perishes, to give rise to their special fruit - some manifestation more august and wonderful of the INFINITE, through the Emblems of TIME?[240]

Nichol's remarks on species transmutation were invariably rather circumspect. In 1846, a lecture to the Edinburgh Philosophical Institution won the approval of the Free Church Magazine by warning of the limits to cosmological speculation. The lecture repeated his earlier warnings about the fragmentary nature of the fossil record. Neither existing creatures nor those of past geological epochs could be expected to form a 'chain of being'. While the development of species including even "their sensitive and intellectual functions" would eventually be seen to be the result of natural law, the author of Vestiges had not produced a satisfactory answer. Indeed, Nichol did not expect that the law could ever be deduced from "mere historic or specific arrangements". He contrasted the solid achievements of astronomers with the speculations of transmutationists; the former dealt with established truths, which the latter had not yet attained. However, Nichol expressed dissatisfaction with the "violent solution" offered by "the hypothesis of successive and unconnected acts of Almighty Power".[241]. His preface to the System of the World similarly disclaimed support for the

> ... unexpected prevalence, manifested in various forms of the most strangely inaccurate and conflicting views as to the connexion of larger inquiries regarding the Order of

> Nature, with points of the deepest interest to man, viz. his conception of his own position and duties amid the Universe, and, as a matter of course, his relation as well as that of all things, to the Providence of the unchangeable Creator;[242]

Once again there were warnings about the limits of existing knowledge, especially of the fossil record, combined with hopes for an eventual explanation of species development in terms of law. What Nichol took away with one hand, he gave with the other. "Surely it is a very limited and feeble Theism", he declared, "which would debar the effort of human reason to extend the sway of "Natural Laws".[243] Yet he also insisted that whatever cosmogony eventually emerged, it would have nothing new to say about the nature and destiny of man.

Constantly emphasising the limits of existing knowledge, Nichol was also anxious to set boundaries on the implications of future theories. His cautious approach seems to have drawn the stings of potential critics. He was on friendly terms with Chalmers. In 1846, he explained to the Free Church leader that as he had been "instrumental in misleading a considerable number" of his countrymen over the nebular theory, he had felt obliged speedily to announce its overthrow.[244] Nichol's works attracted none of the vituperation suffered by Vestiges and by Combe's writings. In 1845, the Witness carried a notice of a series of lectures by Nichol on the physical constitution of the solar system, to be delivered at the request of the Edinburgh Philosophical Asociation. The list of other individuals who had requested the lectures brought together some strange bedfellows, including Miller, Chalmers, Robert Chambers and Andrew Combe.[245] In 1846, the Free Church Magazine praised Nichol for showing "a frankness ... rare in the history of science" in being the first to declare that the nebular theory was untenable.[246] In

1847, the Witness spoke warmly of the good done by his works amongst "the reading classes of this country", placing his name in the distinguished company of Chalmers, Herschel, Mary Somerville and Thomas Dick.[247] While Evangelicals accepted him as a devout astronomer, Nichol showed no signs of abandoning his other role as infidel phrenologist. His continuing loyalty to Combe is indicated in an address given to the Stirling School of Arts in 1849, in which he praised "those men of our time [chiefly George and Andrew Combe], who ... have brought within the comprehension of every cottager, how beneficently the action of God's material ordinances might co-operate towards the happiness and elevation of our race."[248]

Chambers was undeterred by scientific criticism, by Evangelical hostility or by disagreements amongst Combe's circle. He responded to technical criticisms of Vestiges with a volume of Explanations, published in 1845, and by modifications to Vestiges itself. Ogilvie discusses the changing fortunes of the nebular theory through successive editions.[249] In the first four editions (between October 1844 and April 1845) he was firmly convinced of its truth but in the fifth (1846) he admitted to some doubts in the wake of Nichol's announcement. Some of his confidence returned in the ninth (1851) and tenth (1853) editions, as a result of supposed new mathematical support for the theory. Despite his failure to attract plaudits from the scientific community, Chambers must have been considerably satisfied by success of a different kind. Vestiges was a mid-nineteenth century bestseller, reaching its eleventh edition in 1860. The first ten editions accounted for about 25,000 copies, many of them probably bought by readers who had previously devoured Combe's Constitution of Man. In Explanations, Chambers remarked that it was

not surprising that men of science had condemned the book. They were preoccupied with their own specialisations and were prejudiced against wide-ranging views: "it must be before another tribunal, that this new philosophy is to be truly and righteously judged."[250]

Ironically, Chambers continued to enjoy friendly scientific exchanges with some of these specialists, including a number of Evangelical critics of Vestiges. He was an active member of the Royal Physical Society, the Edinburgh natural history society which, from its revival in 1849, took over many functions from the moribund Wernerian Society. Other members included Miller and Fleming. At different times, each shared the presidency of the Society with Chambers.[251] As early as 1839, Miller had noted in Chambers "a sad want of fixed belief in those great truths through whose influence alone the better part of our nature is enabled to assert its due supremacy over the worse."[252] Their friendship nevertheless survived the events of 1844. Whether or not Miller and Fleming believed Chambers to be the author of Vestiges is not known. Infidels perhaps appeared deadlier in anonymous print than in person.

The Evangelical scientists came to the study of geology with different backgrounds and perspectives, which help to account for their different allegiances. Fleming brought to it the Wernerian emphasis on the importance of mineralogy. Indeed, Porter suggests that this concern with the natural history of minerals was typical of Scottish geology at the end of the eighteenth century.[253] Fleming continued to acknowledge the immense superiority of the Wernerians over the Huttonians in their knowledge of the natural history of mineral species. From his Wernerian period he retained throughout his career an aversion to the Huttonian belief in the gradual

elevation and depression of land masses. He also insisted strongly on the independence of mineralogy and petrology from palaeontology, dissenting even from Werner's view that the same geological formations always contained the same fossils. In a paper to the British Association meeting at Glasgow in 1855, he emphasised that palaeontology was really a part of phytology or zoology. Extinct animals and plants should be studied as branches of these subjects, either systematically "as exhibiting many modifications of forms and structures, but imperfectly displayed in the living races" or chronologically "unfolding to us the condition of life on the globe ... by the order of formation and superposition of the beds in which their relics are enclosed."[254] Cautious about admitting that any kind of plan or pattern was evident in the fossil record, Fleming also treated sceptically the evidence for a gradually cooling earth. He therefore provided few hooks on which a transmutationist could hang a theory.

Miller was drawn to geology chiefly by a fascination with the history of life and the interpretation of the fossil record dominated his early writings. His firm commitment to the notion of progress, even discontinuous progress, seemed to render him, like Buckland and other members of the English school, vulnerable to the arguments of Vestiges. However, Miller was able to modify and develop the theological framework of progressionism in a way which answered Chambers and delighted Evangelical Calvinists. Miller's degradation theory had in it something of the flavour, if not the letter, of seventeenth century cosmologies such as Burnet's Sacred Theory.[255]

Brewster was an unreliable and occasionally opportunistic commentator on geology. In astronomy, he was a consistent supporter of the nebular hypothesis from 1838 until the publication of

Vestiges. Although this hypothesis did not originate with Combe's school, its popularity in Scotland owed much to Nichol's efforts. Nichol also hinted at the wider implications of the theory, which Vestiges made quite explicit. Where Nichol had published openly, Chambers worked in secret, without the collaboration even of close friends like Combe. However, as many critics recognised, Vestiges was a direct descendant of the Constitution of Man, generalising its theology of natural laws to a cosmic scale.

Vestiges made a greater impact than any of Combe's works upon the content of Evangelical science. Its most striking effect was the hasty abandonment of the nebular hypothesis, particularly dramatic in the case of Brewster. New observational evidence helped this process but was insufficient on its own to bring about such a rapid change. More generally, Vestiges encouraged the Evangelicals to re-examine the balance between natural law and divine Providence. Before Vestiges they had felt that it was only necessary to hint occasionally at the possibility of direct Providential intervention in the inorganic realm. Spectacular catastrophes such as the explosion of a planet, whether or not the direct result of the Creator's fiat, were felt to be sufficiently impressive to remind an audience that divine Providence was manifested at all times. It was not especially important to distinguish the continuation of the laws of nature from their suspension. After Vestiges, Evangelical writers like Brewster for the first time began to use 'natural law' itself in a pejorative sense. While this did not necessarily lead to a significant change in scientific beliefs, Vestiges definitely heralded a change in the style of Evangelical science. In geology especially, there was an increased emphasis on cataclysmic events,

sometimes coupled with a clear assertion that these were miraculous occurrences.

It is also interesting to see what did not change as a result of Vestiges. Although the Evangelicals quickly dropped the nebular hypothesis, other premises of Chambers' argument, such as the doctrine of a plurality of worlds, suffered hardly at all. Brewster failed even to recognise the intention behind Whewell's Essay on the subject and mistook its anonymous author for a supporter of the development theory. Similarly, Miller chose not to drop the idea of foetal recapitulation from his writings, despite its use in Vestiges. Interestingly, too, the Evangelicals attempted to salvage parts of the cosmological framework in which Chambers had embedded his theory. Nichol's works, with their emphasis on progress in the realm of physical nature, never attracted the anathemas pronounced on the writings of Combe and Chambers.

Partly, this was the result of Nichol's own caution in discussing the implications of his theory. Partly, too, it indicates the continuing appeal of astronomy to Evangelical natural theologians. From Chalmers' Astronomical Discourses onwards, this subject had proved popular with audiences. Presumably it was also perceived to be effective in instilling pious sentiments. In the mid 1840s, annoyed by Vestiges and genuinely believing that the nebular theory had been overturned, Nichol rapidly re-formulated his theories of astronomical progress. As a result, the Evangelicals were able to turn their eyes back to the skies, without fear of finding there some lingering traces of the noxious clouds produced by Vestiges.

Chapter Eight

REFLECTIONS

This study selected four Evangelical men of science for detailed study, although their views have, where appropriate been described as part of a broader canvas. On issues such as the reconciliation of science and Scripture, the status of natural theology, the implications of the Constitution of Man and the dangers of Vestiges, I have tried to discover the views of the Evangelical party (later the Free Church). To establish the collective view on an issue is fraught with difficulties. I have tried to do justice to diversity of opinion where it clearly existed. On some issues a consensus only emerged gradually. In his roles of city preacher, university teacher and Evangelical leader, Chalmers was undoubtedly a major influence on his party's attitude to science and natural theology. Miller, as editor of the Witness, Fleming, in his New College chair of natural science and Brewster, as contributor to the periodical press, must have also helped to mould opinion in the Free Church.

This study has shown that, even amongst the selected group, differences of opinion existed on certain scientific questions, including the interpretation of raised beaches and the evidence for a gradually cooling earth. However, we have also noted the influences which brought the four closer together. In Church politics, they were united by the non-intrusionist battles, by the Disruption itself and by the persecution which Free Churchmen suffered afterwards. On the scientific front, the threat posed by the 'infidel theories' of the Combeists became apparent in the 1830s but was strikingly

confirmed by Vestiges in 1844. Against this external enemy, a united attack had to be launched.

Chalmers' natural theology emerges as an attempt to combine Enlightenment science, with its emphasis on order, stability and harmony, and Calvinist theology, which stressed the Fall, punishment and the personal nature of God's dealings with man. If we return to the questions raised in chapter one about the importance of natural theology, we could explain Chalmer's endeavours merely as the result of a personal fascination with science. Natural theology then appears as a bridge from the scientific to the theological. The intellectual charms of science could be justified both to oneself and to other Evangelicals by making it the handmaiden of religion. However, there seems little doubt that, for the Evangelicals, the bridge also functioned in the opposite direction. The Evangelicals' religious beliefs led them to approach nature with an expectation of finding there abundant testimony to the character of its Creator. Natural theology served as a means of confirming beliefs held prior to the study of external nature. Hooykaas is almost certainly right in suggesting that Miller's religion was "essentially based upon other grounds than those afforded by the study of nature".[1] Natural theology merely accumulated tangible evidence for what the Evangelicals already knew from Scripture and by faith.

In seeking other reasons for the importance of science we leave the consideration of internal psychological needs and beliefs, which are inevitably difficult for the historian to discuss with confidence. Instead, we can turn to social factors: the position of the Evangelical scientists in the scientific community and the role of science in the struggles within the Church of Scotland.

An important factor driving the Evangelical scientists was the desire to be seen as the upholders of Enlightenment ethics of scientific freedom. Brewster, in particular, relished not only the role of the scientist, but also the role of the zealous defender of free inquiry. Indeed, the notion of martyrdom was a recurring theme in his writings.

Such an ethic was a familiar strand in Enlightenment thought. Brewster, Fleming and Chalmers no doubt heard it advanced many times during their education in Edinburgh. However, its importance for the Evangelicals is not explained merely as the result of a process of passive absorption. It was an ideological position regularly reinforced in religious and political controversy. Their initial investment was perceived to pay good dividends.

At the beginning of the period, we saw how the Moderates gave the Evangelicals the opportunity to raise the cry of ecclesiastical tyranny during the Leslie affair. Subsequently, accusations of scientific timidity or even clerical repression were again made to serve religious and political, as well as scientific ends. Fleming tore to pieces Buckland's diluvialism, mainly out of concern for the integrity of science, though Scottish nationalism may have played a part. Brewster's criticisms of the Geological Society of London were parhaps largely motivated by nationalistic concerns. His alignment with Comte against Whewell over the nebular hypothesis stemmed partly from a desire to outdo the cautious Cambridge man in willingness to entertain radical theories. Here the motives were as much personal as political and scientific. Church politics continued to exert an influence on the Evangelical scientists' ideology. They were eager to demonstrate their party's superiority to the Moderates in

scientific matters. This was deemed especially important in gaining favour for the non-intrusionists in liberal circles. In 1841, Brewster wrote proudly to Lord Brougham:

> The Majority of the Church [the Evangelicals] are its noblest pillars, both in Theology and secular learning. They are the hardworking and self-devoted men who sacrifice everything for the People's spiritual interests. They form the party who have supported all the Schemes of Benevolence, Education and Liberty for which your Lordship has so long and so successfully struggled; and if on particular Questions, affecting ecclesiastical rights they have once or twice appeared to abandon liberal principles, it was only to secure a larger measure of religious liberty to their people.
> The Minority of the Church, on the contrary, who, when the dominant party, derived their respectability from the literature and Science of a few of their body, can now scarcely boast a name that is favourably known beyond their Presbytery bounds.[2]

Similarly, in a tirade against the Moderates' record of opposing missions, Sunday schools and chapels of ease, Miller was at pains to minimise the party's past links with science and literature:

> The deep cloud of moral and spiritual death which for a century brooded over our country, withering every bosom of hope and promise, had its upper sunlit folds of purple and gold, to catch and charm the eye of the distant spectator; but to know it in its true character, it was necessary to descend to where its lower volumes brooded over the blighted surface, and there to acquaint one's-self with its sulphurous stench, its mildew-dispensing damps, its chills, and its darkness.[3]

The challenge of the Combeists did not undermine this commitment to free inquiry; rather it increased the importance of disseminating 'correct' forms of natural theology.

The third function of natural theology identified in chapter one - the defence of the social order - was also of considerable importance to the Evangelicals. Chalmers, like Malthus, found it convenient to explain the operation of the economic system in terms of invariant laws, which might from time to time produce unpleasant

consequences, but operated for the general good. Some of the uglier "collocations" of Victorian capitalism were thus shown to be unchangeable by human endeavour. Brewster advocated scientific education as a stabilising influence on the social fabric. Miller recommended scientific studies to working men as an antidote to Chartism.

Did Chalmers' natural theology achieve greater success than its English counterpart in meeting the challenge of deists? Gillispie suggests that Sedgwick and other Broad Churchmen were ill-equipped to deal with Vestiges.[4] They themselves had gone too far in breaking down the boundary between the material and the moral. Even if we do nor accept Gillispie's assessment, it is interesting to consider how Scottish natural theology fared by comparison.

Chalmers' synthesis undoubtedly had weaknesses in that it relied directly on geology for proof of the non-eternity of the world. Chalmers also failed to explain exactly how his principles should be applied to science that was in a state of flux. Today's dispositions might disappear in tomorrow's laws; admittedly, he, himself saw this possibility and offered reassurances about primary laws operating in new circumstances. However, he did not fully resolve the ambiguity of his position over natural laws. Indeed, when he turned to the social and economic systems, his natural theology relied heavily on the operation of inflexible laws.

Fleming, Brewster and Miller seem to have shared Chalmers' views on the strengths and weaknesses of natural theology. However, from a general commitment to Chalmers' principles, it is not possible to predict the stance any individual would take in a particular scientific controversy. Although it generated a uniform style of

science, Evangelical natural theology did not necessarily generate uniformity in scientific beliefs. Brewster's later views on the nebular hypothesis were perhaps more consistent with Chalmers' principles than was his early support for the theory. Chalmers had implied in the Bridgewater Treatise that, though the nebular hypothesis appeared to weaken some aspects of the design argument, it could be tolerated as a hypothesis. This should. perhaps, have warned Brewster away from using it in natural theology, particularly when he himself had condemned those who loaded the design argument with "the lumber of human wisdom."[5] Unfortunately, we do not know Chalmers' opinion of Brewster's enthusiastic adoption of the theory, although Chalmers apparently approved of Nichol's work.

Whether or not Chalmers agreed with Brewster, it is clear that Brewster beat a hasty retreat from the nebular hypothesis after reading Vestiges. The vehemence of his subsequent remarks about natural law and fatalism suggest that he felt he had been 'caught out' by Chambers' book. Similarly, Miller seems to have been sufficiently alarmed by the advance of 'natural law' to have tried to push it back beyond the frontiers which it occupied before Vestiges.

There is a further complicating factor in assessing conformity to or deviance from a particular form of natural theology. Brooke suggests that natural theology's importance in the nineteenth century stemmed partly from its value in bringing together different denominations of Christians.[6] The affirmation of the existence of design in nature was the basis of a 'Broad Church', which set aside differences of opinion over doctrine and form of worship. This was especially important at a time when the credibiility of the Christian faith was felt to be endangered by sectarian fragmentation. It would

also have had the tendency to minimise differences of opinion amongst natural theologians themselves. Such an irenic impulse helps to explain the welcome Chalmers gave to Whewell's natural theology, which differed in many respects from his own. It accounts for the approval, which, even more surprisingly, he bestowed on Babbage's unofficial Bridgewater Treatise. Brewster, a friend of Babbage, similarly praised the Ninth Treatise for its "profound thought" and its "elegance and beauty of composition".[7]

A passage from the Presbyterian Review referring to the Bridgewater Treatises, illustrates the Evangelicals' ability to accept differences of opinion within natural theology, provided that there was agreement about its general aims:

> It was natural when the workmen proceeded to their several tasks, without any mutual understanding, and no very specific plan, that the uniformity of the architecture, and the proportion of the parts should be somewhat marred - that one should interfere with the province of another, or still worse, pull down what another had built up - that on this side there should be more of strength, and on that, more of decoration. This was only to be expected in the circumstances. But once that the work is finished and the eye can judge of the tout ensemble, the prominent defects will appear; nor can the band of coadjutors be better employed, than in retouching the goodly fabric, that so may it be a monument - worthy of the pious munificence that projected, and the masterly skill that reared it - whose stately beauty may be seen from afar, - upon the sides of which thousands may yet trace, not the mystic hieroglyphics of an Egyptian pyramid, or the ignorant inscriptions of the Athenian altar, but letters, which he who runs may read, and he who reads may understand, exhibiting in bright relief the power, the wisdom and the goodness of the great Creator.[8]

There were occasions when the irenic impulse was overborne by other pressures. Brewster's review of Whewell's Bridgewater Treatise was an example. Brewster's opposition to the wave theory of light and to the scientific values of the Cambridge group, combined with anger over his failure to win the natural philosophy chair, prompted

him to write an article which was hostile but also, in a sense, remarkably honest. It highlighted the ambiguities which natural theologians had not properly faced. For instance, there was the difficulty of deriving "a formula of gratitude", first from the stability and then from the forthcoming dissolution of the solar system. Although Brewster himself was later able to make this transition, his criticisms of Whewell give an embarrassingly clear glimpse of natural theology's shaky intellectual foundations.

Measurements of the relative strength of the Evangelical response to Vestiges in comparison with the 'English' refutations must inevitably be subjective. We can notice, in particular, the admiration expressed by Murchison, Buckland and others for Miller's Footprints of the Creator. By contrast, some opponents of Vestiges considered that Sedgwick's article for the Edinburgh Review was an ineffective response.[9] Undoubtedly, Brewster's savage criticisms of the nebular theory and Miller's eloquent attack on the geology of Vestiges had an impact on Chambers, who devoted considerable space to answering them in later editions of Vestiges. While noting the energy and power of the Evangelical's response to Vestiges, I would not go all the way with the attempts of Hooykaas and Gillispie to isolate Miller, in particular, from English natural theologians. Though Miller's religion was based upon "other grounds than those afforded by the study of nature", this is simply a statement about the man's personal beliefs. It certainly did not imply that he was indifferent to the theological implications of particular theories about the development of species. He was deeply concerned about the effects of Vestiges and similar theories on the minds and beliefs of others.[10] Hooykaas implies that had there been good scientific

evidence for the transmutation theory, Miller would have "acquiesced ... readily".[11] It is perhaps fruitless to speculate on what would have happened had Miller lived to see the publication of the Origin of Species. However, all the evidence suggests that he would have joined Brewster on the anti-Darwinian side.

I have discussed the dual function of Chalmers' natural theology in harmonising science with Calvinistic Christianity and in defending the social order. Let us now consider in more detail the purposes fulfilled by the natual theology of Combe. We have already noted the value of invariant natural laws in taking from the clergy the ability to seek change to the natural order through prayer. The doctrine also challenged the churches' ability to interpret epidemics and disasters as the visitations of Providence. Secondly, the Combeists used the natural laws in a spirit of radical empiricism, which mirrored claims for phrenology. If phrenology enabled us to understand the human mind, the natural laws represented an easily-attained vantage point from which to see into the divine mind. Christian theology was lumped with other discarded forms of knowledge for being complicated, abstruse and esoteric. Scientific inquiry on the other hand was represented as exoteric, clear and leading to firm conclusions. Anyone could participate. Indeed all had a right to do so. In 1835, the Scotsman declared of the Edinburgh Philosophical Association:

> It is a proud boast for Edinburgh, that there, for the first time in the history of society, the commercial and business classes, for whom the gates of Colleges have not been wont to lift up their heads, have, in these brighter days for mankind, 'risen', and demanded science for themselves, ... asserted their right to 'know the Creator's works that they may the better understand and apply his Word', and without patronage, nay in the face of some sneers and discouragements, achieved for themselves an easy

path to the temple of scientific light.[12]

Shapin points out that, although the Combeists' cosmology collapsed social hierarchies, Combe himself did not see them as totally collapsed.[13] Despite his insistence that all the faculties were, in principle, good, he continued to arrange them hierarchically, valuing most highly the moral sentiments and intellect. Similarly, while the natural laws represented an easy route to divine truth, the route was not so easy that the untutored might travel it alone. There was an enormous number of laws, many of them still undiscovered. Moreover, individuals varied in their abilities to arrive at truth. Since some mental constitutions were superior to others, it was only to the best minds that one should turn in order to discover the correct moral laws. Combe remarked in Moral Philosophy:

> In my opinion, the decisions of those individuals who possess the largest development of the moral and intellectual organs, and the most favourable combination of them in relation to each other and to the organs of the animal propensities; who also possess the most active temperaments, and who have cultivated all those gifts to the highest advantage, will be entitled to the greatest respect as authorities on morals and religion, whether these be founded on interpretations of God's works, or on interpretations of Scripture. If this standard be imperfect, I know of no other.[14]

Combeism not only undermined the role of the clergy. It justified the existence of a secular priesthood. It was a form of scientism, forerunner of other movements which have argued that social policy should be determined by deference to the views of scientific experts.[15] The eugenics movement of the late nineteenth and early twentieth centuries is an example.[16] Thirdly, the natural laws had a symbolic function in relation to the social and political aspirations of the Combeists. They desired a society free from aristocratic

privilege, and governed according to science and reason. Whilst the natural laws served individually as prescriptions for human behaviour, collectively they provided a model for this future society. The universe was republican in its constitution. God did not dispense favours capriciously, like some monarch swayed this way and that by the supplications of favoured subjects. In nature's republic, all were equal before the law. By contrast, in human society, the law served the interests of a land-owning aristocracy. William Hodgson underlined the point in a letter to someone who had suggested that political economy provided objections to the divine benevolence:

> Your difficulty as to Economic Science seems to me wholly to arise from your confounding the eternal and divine laws with mere human legislation, which has everywhere thwarted and does everwhere still thwart, the natural conditions of prosperity and happiness.[17]

This study has described the conflict between Evangelicals and Combeists in a variety of contexts. The common factor is the framework for their disagreements provided by science and natural theology. Over Revealed theology, the Combeists preferred to avoid controversy. Neither side can be considered to have 'won' these arguments. In the educational controversies, the Combeists failed to achieve their aim of freeing elementary education entirely from clerical influence. On the other hand, the Disruption and other sectarian fragmentation eventually reduced the extent to which the Church of Scotland controlled the parish schools. Free Churchmen like Miller and Brewster latterly favoured inter-denominational schools.

Measurement of success in the other areas discussed in this study is more difficult. Large numbers of people bought and read the

works of Combe's school, but the extent to which such readers shared Combe's scepticism about orthodox Christianity is of course difficult to establish. The effects of the Constitution of Man and Vestiges are no doubt buried deep in the statistics of Victorian church attendance. Although the data in the religious census of 1851 are almost certainly inaccurate, they expose the idea of near universal attendance as a modern myth. Drummond and Bulloch report that a survey of the city's churches in 1881 by the Glasgow United Evangelistic Society revealed that the combined attendances of all services amounted to about 16% of the population; "there seems no real ground to suppose that the facts of 1851 were very different."[18] While noting the high sales of the Combeists' works and their possible effects in spreading, or giving intellectual foundation, to infidelity, I should mention that Miller's books were also bestsellers. The Old Red Sandstone, for instance, remained in print into the twentieth century.

Andrew Combe died in 1847, Simpson in 1853, George Combe in 1858, Nichol in 1859, so that the Combeist school was virtually extinguished by 1860. Maclaren died in 1866. Chambers survived until 1871, but after his wife's death in 1863 became converted to spiritualism.[19] After holding a variety of educational appointments, Hodgson became professor of commercial and political economy and mercantile law at Edinburgh University in 1871. He died in 1880. The faculty psychology continued to attract adherents in Britain into the twentieth century. However, the decline in interest in the subject had begun even before Combe's death. Phrenology and the natural laws provided the intellectual foundation for the efforts of a number of social reformers who survived into the second half of the

nineteenth century, such as William Ellis (d.1881). Frequently, however, these reformers showed more interest in achieving their immediate practical goals than in proselytising for a philosophical system. Combeism also helped to supply later secularist leaders, like George Jacob Holyoake, with a rationale for rejecting the teachings of Christianity. Holyoake, who had on one occasion acted as assistant to Combe at a phrenological lecture, recalled that the Constitution of Man, basing morality on natural law, was "welcomed among students as the new Gospel of Practical Ethics."[20]

Of the Evangelical scientists, Brewster was the longest surviving. His robust defence of the independence of science and Scripture lost some of its vigour in the 1860s. His signature of the Declaration provides evidence of his isolation from a wide section of opinion in the scientific community. However, this may have been largely the result of his age and consequent failure to keep abreast of the most recent scientific developments. To assess more accurately the fate of the ideas nurtured by the Evangelical school, we need to look at the influence of their successors such as James McCosh (1811-94). McCosh attended Chalmers' lectures in Edinburgh and, during the 1830s, became concerned about Combe's ideas on natural law. His work, The Method of the Divine Government (1850) developed and modified Chalmers' distinction between laws and collocations.[21] In 1851 McCosh became professor of logic and metaphysics at Queen's College, Belfast and in 1868 was elected president of Princeton College, New Jersey. Despite having attacked Vestiges, he eventually accepted the Darwinian theory of evolution.[22] His ideas were much admired by Miller.[23] Phillipson suggests that with the death of Chalmers and McCosh's departure for America,

control of the Free Church passed to "the old-fashioned Evangelicals and to neo-scholastic professors of theology who had little time for a faith rooted in the increasingly treacherous marshes of natural theology."[24] A study of science and belief in Scotland from Brewster's death in 1868 to the end of the century might reveal some exceptions to this assessment. The reception of the Origin of Species could provide a suitable focus for such a project, building on the work of Moore.[25]

NOTES

Chapter One

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Chapter Three

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27 [David Brewster], 'Whewell's History of the Inductive Sciences', Edinburgh Review 66 (1837), 110-51.

28 David Brewster to Henry Brougham, December 14, 1841, UCL MS. 26.624. See also David Brewster to John W. Lubbock 25 June 1841, Royal Society MS. B.429 where he declared he was "greatly annoyed" at the refusal of the Royal Society to print the paper and that this must have been at the insistence of William Whewell or George Airy.

29 David Brewster to Henry Brougham, May 9, 1832 and Bishop of Cloyne to David Brewster, April 5, 1832, UCL MS. 15.728.

30 David Brewster to Charles Babbage, March 26, 1832, BL Add. MS. 37186 f.297.

31 David Brewster to Henry Brougham, September 14, 1833, UCL MS. 43.049.

32 David Brewster to Macvey Napier, January 25, 1837, BL Additional MS. 34618 f.17. The article was [Alexander Smith], 'Evangelical Preaching', Edinburgh Review 64 (1837), 428-52.

33 David Brewster to Macvey Napier, March 6, 1838, BL Additional MS. 34618 f.604.

34 The Edinburgh Advertiser, January 4, 1833 reported that Chalmers had suggested Brewster would be "Brilliant", Galloway (the third candidate) "Useful" and Forbes "both". See David Brewster to Macvey Napier, January 25, 1833, BL Add. MS. 34616 f.14, where Brewster complained that Chalmers had acted "strangely" in stating privately to Brewster that he considered him by far the best qualified candidate whilst declining to express a public opinion unless it were officially requested. For more on the 1833 contest, see Steven Shapin, 'Brewster and the Edinburgh Career in Science', in Morrison-Low and Christie, 'Martyr of Science', 17-23.

35 R.D. Anderson, 'Brewster and the Reform of the Scottish Universities', in Morrison-Low and Christie (eds.) 'Martyr of Science', 31-34.

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NOTES

Chapter Six

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Annals of Science 32 (1975), 195-218.

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16 George Combe, Essay on the Constitution of Man, and its relations to External Objects (Edinburgh, 1827), Preface.

17 de Giustino, Conquest of Mind, 132.

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22 'Review of Spurzheim on Education', Edinburgh Christian Instructor 20 (1821), 615.

23 [George Lyon], 'On the Harmony of Phrenology with the Scripture Doctrine of Conversion', Edinburgh Christian Instructor 22 (1823), 803-18. The authorship of this article is revealed in a review in Phrenological Journal 1 (1823-4), 269-74. For another favourable Evangelical article on phrenology, see 'Review of the Phrenological Transactions and Journal', Edinburgh Christian Instructor 23 (1824), 181-94.

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25 George Combe to David Welsh, June 16, 1826, NLS MS.7383 f.340.

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37 'Literature', Scotsman, October 28, 1835 (review of George Combe, The Constitution of Man considered in Relation to

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38 Combe, Constitution of Man, 7-8.

39 Ibid., 204.

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46 Combe, Constitution of Man, Second edition, 4-5.

47 David Welsh to George Combe, January 9, 1828, NLS MS.7222 f.155.

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53 William Scott, Remarks on Mr. Combe's Essay on the Constitution of Man, and its Relations to External Objects (Edinburgh, 1827), 36. For Combe's reply see [George Combe], Notes in Answer to Mr. Scott's Remarks on Mr. Combe's Essay on the Natural Constitution of Man (Edinburgh, 1827).

54 William Scott, A Few Last Words to Mr. Combe on the subject of his Essay on the Natural Laws (Edinburgh, 1828), 13-14.

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56 Ibid., 59.

57 'Philomathes', 'Phrenological System of Education Letter IV', Edinburgh Advertiser, January 7, 1834.

58 Philomathes, 'Phrenological System of Education', Edinburgh Advertiser, 24 December, 1833. Philomathes' other letters appeared in: Edinburgh Advertiser, December 3, 1833; January 3, 1834; January 10, 1834; January 24, 1834. For Combe's reply, which suggested that Pyper was responsible for the letters, see George Combe, 'Lectures on Popular Education by George Combe', Edinburgh Advertiser, January 7, 1834. See also William Pyper, 'Letters of Philomathes', Edinburgh Advertiser, January 10, 1834 in which he replied to Combe without actually denying that he was the author.

59 Full particulars of British editions of the Constitution of Man with the numbers of copies printed to 1836 are as follows: (Edinburgh, 1828): 1500; Second edition (Edinburgh, (March) 1835): 300; Third edition (Edinburgh, (August) 1835): 1000; Fourth (People's) edition (Edinburgh, (October) 1835): 12,000 to March 1, 1836, 32,000 to October 1836; Fifth edition (Edinburgh, (November) 1835): 1000; Sixth edition (Edinburgh, (March) 1836): 1500; Seventh edition (Edinburgh, (October) 1836): 3000. These figures are contained in 'Advertisement', Seventh edition, where Combe is anxious to refute the charge that sales have been "chiefly to the lower orders of the people"; i.e. principally of the People's edition, which cost 1s.6d. compared with 6s. (later reduced to 4s.) for the duodecimo editions (Seventh edition, v).

60 'Combe on the Constitution of Man', Edinburgh Christian Instructor (1836), 522.

61 'Literature', Scottish Guardian, July 15, 1836.

62 For other Evangelical attacks on Combeism from the same year, see for instance, 'Scott's Harmony of Phrenology with Scripture', Edinburgh Christian Instructor 5 (1836), 587-94; 'Combe's Constitution of Man', Presbyterian Review 9 (1836-7), 92-118; 'The Harmony of Phrenology with Scripture', Church of Scotland Magazine 3 (1836), 366-76, 445-54.

63 George Combe to Patrick Neill, May 20, 1836, NLS MS.7887 f.8.

64 William Scott to George Combe, September 18, 1828, NLS MS.7222 f.62.

65 William Scott to George Combe, April 20, 1830, NLS MS.7226 f.91 is among letters dealing with the sale of Scott's share in the Journal.

66 William Scott, The Harmony of Phrenology with Scripture: shown in a Refutation of the Philosophical Errors contained in Mr.

Combe's "Constitution of Man" (Edinburgh, 1836), 156.

67 Verus, 'Phrenology to Philomathes', Edinburgh Advertiser, December 27, 1833.

68 George Combe to Mrs Walter Campbell Islay, November 22, 1831, in Gibbon, Life of George Combe, i, 236.

69 Ibid., i, 241-42.

70 George Combe to George Mackenzie, July 18, 1832, NLS MS.7385 f.353.

71 Alexander Dunlop, 'Memoir' in Sermons by the late Reverend David Welsh, D D with a memoir by A. Dunlop, Esq. Advocate (Edinburgh, 1846), 14.

72 George Combe to Andrew Combe, July 2, 1836, NLS MS.7387 f.47.

73 'Phrenology and the Church', Church Review 1 (1836), 396. For attacks on Combeism in the Church of Scotland press after the Disruption, see, for instance 'Buffooneries of Modern Education', Macphail's Edinburgh Ecclesiastical Journal 8 (1850), 97-109.

74 Church Review 1 (1836), 385.

75 'Literature', Scottish Guardian, October 11, 1836.

76 George Combe to Patrick Neill, May 15, 1836, in Testimonials on behalf of George Combe, as a Candidate for the Chair of Logic in the University of Edinburgh (Edinburgh, 1836), 116-17.

77 George Combe to Andrew Carmichael, July 16, 1836, NLS MS.7387 f.67.

78 George Combe to James Simpson, May 6, 1836. NLS MS.7386 f.554. Combe reports that Welsh declined to provide a certificate, even in favour of phrenology, on account of Combe's religious opinions.

79 Alexander Duncan to Patrick Neill, April 28, 1836, in Testimonials on behalf of George Combe, 110. Other clergymen who gave Combe testimonials inluded the Rev. George Lawson of Kilmarnock (Associate Synod), and the Rev. Adam Brown of the Cameronian Chapel, Kilmarnock.

80 George Combe to ? (unreadable), December 28, 1835, NLS MS.7386 f.450. The review referred to was probably 'Combe on the Constitution of Man', United Secession Magazine 3 (1835), 564-570. The reviewer felt that Combe's views tended to undermine the doctrines of the Bible but conceded that the book contained "much that is new, instructive and useful". The article was considerably less vehement in tone than those in the Scottish Guardian, Presbyterian Review etc. on the same subject. For a

more hostile review in a Dissenting journal, see 'Combe's Constitution of Man', Christian Journal 4 (1836), 542-53.

81 For an account of Andrew Combe's career, see George Combe, The Life and Correspondence of Andrew Combe, M.D. (Edinburgh, 1850).

82 James Simpson, Necessity of Popular Education, as a National Object; with hints on the Treatment of Criminals, and Observations on Homicidal Insanity (Edinburgh, 1834); idem, The Philosophy of Education; with its Practical Application to a System of Popular Education as a National Object, Second edition (Edinburgh, 1836).

83 For a biography of Hodgson, see J.M.D, Meiklejohn (ed.) The Life and Letters of William Ballantyne Hodgson (Edinburgh, 1883). Hodgson received testimonials for the Liverpool position from, among others, Andrew Combe, William and Robert Chambers, and James Simpson. Time pressures apparently prevented George Combe, Charles Maclaren, J.P. Nichol and Hewett Watson from submitting testimonials (Testimonials in favour of Mr. William Ballantyne Hodgson, of Edinburgh [for the Secretaryship of the Mechanics' Institution, Liverpool] (? , 1839).

84 Dictionary of National Biography s.v. 'Nichol, John Pringle'.

85 'Mr J.P. Nichol', Scotsman, October 24, 1835.

86 For a reference to Combe's recommendation of Nichol, see William Fraser to George Combe, January 9, 1835, NLS MS.7235 ff.25-26.

87 Testimonials on behalf of George Combe, 23.

88 Robert Chambers, Traditions of Edinburgh, 2 vols. (Edinburgh, 1825).

89 Robert Chambers, Scottish Ballads; collected and illustrated by R. Chambers (Edinburgh, 1829); idem, Scottish Songs; collected and illustrated by R. Chambers, 2 vols. (Edinburgh, 1829).

90 Robert Chambers to George Combe, December 14, 1833, NLS MS.7230 f.51.

91 Robert Chambers to George Combe, November 25, 1835, NLS MS.7234 f.140.

92 Testimonials on behalf of George Combe, 56.

93 See R. Cox and J. Nicol (eds.), Select Writings, Political, Scientific, Topographical, and Miscellaneous, of the late Charles Maclaren ... With a Memoir and Photographs, 2 vols. (Edinburgh, 1869). For a history of the Scotsman newspaper, see Magnus Magnusson et al., The Glorious Privilege. The History of "The Scotsman", (London: Nelson, 1967).

94 George Combe to David Welsh, February 18, 1827, NLS MS.7383

f.414.

95 'Literary and Scientific Society of Edinburgh 1848-9', Tait's Edinburgh Magazine 16 (1849), 48.

96 John Heiton, The Castes of Edinburgh, Third edition (Edinburgh, 1861), chap.6.

97 'Scott on the Harmony of Phrenology with Scripture', Phrenological Journal 10 (1836-7), 235. See Gibbon, Life of George Combe, ii, 6. For further evidence of Combe's reluctance to answer Scott in detail, see for instance, George Combe to J.P. Nichol, August 25, 1836, NLS MS.7387 f.84, where Combe reports William Chambers' view that Scott's book "will be bought and believed in by the fanatics who will never read my book; but that it will produce no effect on philosophical thinkers".

98 Hewett Cottrell Watson, An Examination of Mr Scott's Attack upon Mr Combe's 'Constitution of Man' (London, 1836).

99 [J.P. Nichol], 'Mr. William Scott and the Church versus Mr. Combe's "Constitution of Man"', Scotsman, January 11, 1837. Gibbon, Life of George Combe, ii, 6, states that Nichol was the author. For further evidence, see J.P. Nichol to George Combe, August 21, 1836, NLS MS.7240 f.198; J.P. Nichol to George Combe, August 21, 1836, NLS MS.7240 f.204; J.P. Nichol to George Combe, January 12, 1837, NLS MS.7387 f.238.

100 The First and Second Book of Discipline. Together with some Acts of the Generall Assemblies, clearing and confirming the same: and an Act of Parliament (Amsterdam, 1621).

101 Laurance J. Saunders, Scottish Democracy 1815-1840: The Social and Intellectual Background (Edinburgh: Oliver and Boyd, 1950), 282.

102 These figures are contained in T.C. Smout, A History of the Scottish People, 1560-1830 (London: Fontana, 1972), 367, 440.

103 [George Lewis], Scotland, A Half-Educated Nation, both in the quantity and quality of her Educational Institutions. By the editor of the "Scottish Guardian" (Glasgow, 1834).

104 Chalmers, On the Power, Wisdom and Goodnes of God, i, 186.

105 Simpson, Philosophy of Education, 19. Other members of Combe's circle may have felt that Simpson took an unduly pessimistic view of the condition of the labouring class. See 'Literature', Scotsman, April 12, 1834 (review of James Simpson, The Necessity of Popular Education as a National Object, with Hints on the Treatment of Criminals, and Observations on Homicidal Insanity (Edinburgh, 1834)) where the reviewer remarks that "the physical and mental condition of the operative class of the people is, in general, higher than he estimates."

106 Smout, Scottish People, chap.17.

107 David Stow, Moral Taining Infant and Juvenile, as applicable to the condition of the population of large towns, Second (enlarged) edition (Glasgow, 1834), 264.

108 Lewis, Scotland, a Half-Educated Nation, 83-84.

109 de Giustino, 'Phrenology in Britain', chap.7.

110 Simpson, Philosophy of Education, 29.

111 Ibid., 124.

112 George Combe, Secular Education. Lecture on the Comparative Influence of the Natural Sciences and "The Shorter Catechism", on the Civilization of Scotland (Edinburgh, 1851), 7. See also, idem, Remarks on National Education (Edinburgh, 1847); idem, What should Secular Education embrace? (Edinburgh, 1848).

113 A Director of the Edinburgh Infant School Society to the Editor, London Courier, in 'Infant School System in Edinburgh and Glasgow', Scottish Guardian, June 26, 1835.

114 'Mr. Simpson's Addresses to the Working Classes', Scotsman, October 3, 1838.

115 William Ballantyne Hodgson, The Secular, the Religious, and the Theological (Manchester, 1850), 5.

116 George Combe to Robert Broadley, Feburary 16, 1836, NLS MS.7386 ff.492-3.

117 Hodgson, The Secular, 9.

118 Simpson, Philosophy of Education, 26.

119 'Summary', Scotsman, December 6, 1848. The Marnoch case was one of the major battles over non-intrusionism during the Ten Years conflict.

120 'Reviews - Simpson's Necessity of Popular Education', United Secession Magazine 3 (1835), 327.

121 'Literature', Scottish Guardian, November 9, 1837.

122 For an account of Wilderspin's work, see Phillip McCann, Samuel Wilderspin and the Infant School Movement (London: Croom Helm, 1982?).

123 For more on nineteenth century infant education, including the work of Owen, Wilderspin, Pestalozzi and Simpson, see William A. Stewart and William P. MacCann, The Educational Innovators 1750-1880 2 vols. (London: Macmillam, 1967-8). Many of Owen's educational writings are brought together in Harold Silver

(ed.), Robert Owen on Education (London: Cambridge University Press, 1969).

124 Samuel Wilderspin, A System for the Education of the Young applied to all the Faculties; Founded on Experience on Many Thousands of Children, in many parts of the Three Kingdoms (London, 1840).

125 For a brief biography of Stow see George P. Inish, The Life and Work of David Stow Commemoration Lecture to the Royal Philosophical Society of Glasgow (Edinburgh: Lindsay, 1938).

126 Stow, Moral Training, 25.

127 Ibid., 76.

128 'Literature', Scotsman, December 22, 1847 (review of David Stow, National Education - The Duty of England in regard to the Moral and Intellectual Elevation of the Poor and Working Classes. Teaching or training? (London, 1847)).

129 'Infant School System in Edinburgh and Glasgow' (see note 113).

130 David Stow to the Editor, London Courier, June 15, 1835, in 'Infant School System in Edinburgh and Glasgow' (see note 113).

131 For accounts of the Aberdeen schools of industry see Alexander Thomson, Industrial Schools; their Origin, Rise, and Progress in Aberdeen (Aberdeen, 1847); A. Allan MacLaren, Religion and Social Class: The Disruption Years in Aberdeen (London: Routledge and Kegan Paul, 1974), chap.7.

132 Thomas Guthrie, A Plea for Ragged Schools; or Prevention Better than Cure, Second thousand (Edinburgh, 1847), 17. For other material on moral and spiritual destitution, see also idem, The City: its Sins and Sorrows. Being a series of sermons from Luke xix.41 (Glasgow, 1859).

133 Guthrie, Plea for Ragged Schools, 34.

134 'Literature', Scotsman, March 13, 1847.

135 Chambers' Edinburgh Journal, November 15, 1845.

136 Scotsman, March 24, 1847.

137 Report of a Discussion regarding Ragged Schools; with the Speeches of Lord Murray, Sheriff Speirs, Professor Gregory, Rev. Thomas Guthrie, James Simpson, Esq., Rev. Dr. Alexander, Rev. Mr. Drummond and James Tytler, Esq., Held in the Music Hall, Edinburgh, on Friday July 2, 1847. (Edinburgh, 1847), 37.

138 Ibid., 41.

139 For a general account of the development of adult education, see

Thomas Kelly, A History of Adult Education in Great Britain Second edition (Liverpool: Liverpool University Press, 1970).

140 For Dick's proposals for popular scientific instruction, see Thomas Dick to the Editor, March 4, 1814, May 1, 1814 and October 27, 1814, Monthly Magazine; or British Register 37 (1814), part I, 219-21, 507-10; part II, 23-25, 121-22, 503-6. See also Thomas Dick, On the Improvement of Society by the Diffusion of Knowledge; or, an Illustration of the Advantages which would result from a more General Dissemination of Rational and Scientific Information among all Ranks (Edinburgh, 1833); idem, The Mental Illumination and Moral Improvement of Mankind: or, an Inquiry into the means by which a General Diffusion of Knowledge and Moral Principle may be Promoted (? , 1836).

141 There is no recent full study of the School of Arts, but some relevant material can be found in Steven Shapin and Barry Barnes, 'Science, Nature and Control: Interpreting Mechanics' Institutes', Social Studies of Science 7 (1977), 31-74.

142 Maxine Berg, The Machinery Question and the Making of Political Economy, 1815-1848 (Cambridge: Cambridge University Press, 1980), chap.7.

143 For more on the history of the Glasgow Mechanics' Institution, see A.H. Sexton, The First Technical College (Glasgow, 1894); James Muir, John Anderson, Pioneer of technical education and the college he founded, Edited by James Macauley (Glasgow: John Smith, 1950).

144 'Literature', Scotsman, July 8, 1835.

145 'Edinburgh School of Arts', Scotsman, September 17, 1836 (reprinted from Edinburgh Weekly Chronicle).

146 For brief accounts of the Society's early history, see Popular Education. Address to the Public, by the Directors of the Edinburgh Philosophical Association (Edinburgh, 1835); Simpson, Philosophy of Education, 238-49.

147 For an account of this episode, see Steven Shapin, '"Nibbling at the teats of science": Edinburgh and the Diffusion of Science in the 1830s', in J.B. Morrell and I. Inkster (eds.) Metropolis and province: British science 1780-1850 (London: Hutchinson, 1982).

148 See 'Lectures to the Working Classes', Scotsman, November 4, 1835, which reproduces part of an address issued by the society to "their fellow-citizens of the Working Classes in Edinburgh."

149 See for instance, J.P. Nichol to George Combe, December 4, 1835, NLS MS.7236 f.9, where Nichol expresses concern that Simpson's lectures may not be sufficiently stimulating to hold the interest of his audience. Afterwards, Nichol evidently revised his opinion; see J.P. Nichol to George Combe, December 7, 1835, NLS MS.7236 f.11.

150 'Association of the Working Classes, for their Intellectual, Moral and Social Improvement', Scotsman, October 14, 1837. I have no positive evidence that this was the same organisation but the similarity of name and the link wth Combe's circle suggests that it might have been. The laws of the Associaton described it as intended "to incite and enable the working classes, by means of cheap lectures, publications, meetings, or otherwise, to improve their temporal condition; in other words, to reduce to practice the views for the improvement of mankind, as organic, moral, and intellectual beings, which have been suggested by recent popular writers on intellectual and moral philosophy and physiology." (Appendix, No.V in William Ballantyne Hodgson, Lecture on Education: delivered in the Freemasons' Hall, at the Opening of the Edinburgh Association of the Working Classes, for their Social, Intellectual and Moral Improvement, Monday 16th October, 1837 (Edinburgh, 1837), 46.

151 Combe, Constitution of Man, 12.

152 Ibid., 216-7.

153 George Combe, Moral Philosophy, or the Duties of Man considered in his Individual, Social, and Domestic Capacities (Edinburgh, 1840), 60.

154 James Simpson, Brief Reports of Lectures delivered to the Working Classes of Edinburgh, on the means in their Own Power of Improving their Character and Conditions (Edinburgh, 1844), 6.

155 Andrew Combe, A Treatise on the Physiological and Moral Management of Infancy (Edinburgh, 1840), 351.

156 Combe, Moral Philosophy, 27.

157 Combe, Constitution of Man, 13.

158 'Fast and Prayers against the Cholera', Scotsman, January 11, 1832.

159 Combe, Constitution of Man, 265.

160 'Cholera - Ignorance and Knowledge', Phrenological Journal 7 (1832), 469.

161 George Combe, On Teaching Physiology and its Application in Common Schools (Edinburgh, 1857), 13-14.

162 C.J. Kennedy, Nature and Revelation Harmonious: A Defence of Scriptural Truths assailed in Mr. George Combe's work on "The Constitution of Man, considered in relation to External Objects" (Edinburgh, 1846), 131.

163 Brian Harrison, Drink and the Victorians: The Temperance Question in England, 1815-1872 (London: Faber and Faber, 1971), 184.

164 Simpson, Philosophy of Education, 9.

165 William Ballantyne Hodgson, 'On the Importance of the Study of Economic Science as a branch of Education for all Classes', in Lectures on Education delivered at the Royal Institution of Great Britain (London, 1855), 313.

166 Thomas Chalmers, The Christian and Civic Economy of Large Towns, 3 vols. (Glasgow, 1821-26), iii, 382.

167 Ibid., 401.

168 Combe, Constitution of Man, 226.

169 Ibid., 231.

170 Combe, Moral Philosophy; or the Duties of Man considered in his Individual, Domestic, and Social Capacities Third [People's] edition (Edinburgh, 1846), 100.

171 George Combe to J.P. Nichol, December 13, 1836, NLS MS.7387 f.215. Combe's brother, Abram, was a follower of Owen's teachings. For more on the relationship between phrenology and Owenism see Cooter, 'Cultural Meaning of Popular Science', chap.7.

172 George Combe to John Stirling, January 2, 1836, NLS MS.7386 f.462.

173 'Literature', Scotsman, February 22, 1832.

174 Address by George Combe, reported in 'School for Secular Education', Scotsman, December 2, 1848.

175 Combe, Constitution of Man, 169.

176 For hostile articles on phrenology see [Gordon], 'Doctrines of Gall and Spurzheim' (see note 9); [Francis Jeffrey], 'Phrenology', Edinburgh Review 44 (1826), 253-318.

177 Henry Cockburn, Journal of Henry Cockburn being a Continuation of the Memorials of His Time, 1831-1854, 2 vols. (Edinburgh, 1874), i, 74 (entry for October 29, 1834).

178 [Alexander Smith], 'Phrenological Ethics', Edinburgh Review 74 (1842), 376-414.

179 'Glasgow Mechanics' Institution', Scottish Guardian, October 26, 1837.

180 In 1833, the Institution offered lectures on phrenology by Dr. [Robert?] Hunter (Scottish Guardian, June 21, 1833). John Wood was appointed lecturer on popular anatomy, physiology and phrenology in succession to Hunter. In 1837 (the year the Guardian made its particular recommendation of the Institution's

lectures) there appear not to have been any lectures on phrenology, but a prize was awarded by George Combe for the best essay on "Phrenology and its applications" (Scottish Guardian, May 16, 1837).

181 'Mechanics' Institutions of Scotland', Scottish Guardian, March 5, 1833.

182 'Chambers' Moral Class Book', Edinburgh Christian Instructor 3 (1840), 72.

183 Prospectus of a Religious Periodical, under the Name of the "Scottish Christian Herald", to be published weekly in Edinburgh - under the superintendence of Ministers and Members of the Established Church (Edinburgh, 1836), 2.

184 George Combe to ?, November 17, 1835, NLS MS.7386 f.405.

185 'Popular Lectures on Mind and Morals, and the Structure and Functions of the Human Body', Scotsman, April 9, 1836.

186 'Combe on the Constitution of Man', Edinburgh Christian Instructor 5 (1836), 525-6.

187 'Edinburgh', Scottish Guardian, April 12, 1836 and April 26, 1836. For Combe's reply, see George Combe, The Suppressed Documents; or, an Appeal to the Public against the Conductors of the Scottish Guardian (Glasgow, 1836).

188 Prospectus of the Philosophical Institution, to be Established in Edinburgh, Consisting of a Library and Reading Room, a News-Room, etc., and in which courses of Popular Lectures on the more interesting branches of Science, Arts and Literature, will be regularly delivered (Edinburgh, 1846), 7.

189 William Ballantyne Hodgson to Dr.? Smith, n.d. [1857], in Meiklejohn (ed.), Life and Letters, 214. John Tulloch was a minister of the Established Church who became principal of St. Mary's College, St. Andrews; John Morell was a philosophical writer who lectured in Edinburgh and Glasgow in 1848. William Hanna was Chalmers' biographer; 'Nichol' was J.P. Nichol; Ramsay was an Episcopalian minister.

190 David Brewster, Address delivered to the members of the Edinburgh Philosophical Institution, on the 11th November, 1851 (London, 1852). Hugh Miller, Sketch-book of Popular Geology; being a Series of Lectures delivered before the Philosophical Institution of Edinburgh (Edinburgh, 1859); idem, The Testimony of the Rocks or Geology in its Bearings on the Two Theologies, Natural and Revealed (Edinburgh, 1857), lectures 1, 2, 5 and 6.

191 For a history of the Institution, see W. Addis Miller, The "Philosophical": A Short History of the Edinburgh Philosophical Institution and its Famous Members and Lecturers 1846-1948 (Edinburgh, 1949).

192 Letter of Thomas Scott [the Institution's Secretary], in 'Advertisement' in William H. Gillespie, Combe versus the Heathen - Or, a Proof, from Facts, of the Falsity of Mr. Combe's Dogma Concerning some Heathen Nations (Edinburgh, 1837). For a disparaging reference to the Institution, see Hodgson, Lecture on Education, 33.

193 United Secession Magazine 3 (New Series), (1846), 233.

194 Report of the Proceedings of the First Public Meeting of the Scottish Association for Opposing Prevalent Errors, Held in the Saloon of Gibb's Royal Hotel, Princes Street, Edinburgh on 9th March, 1847 (Edinburgh, 1847), 12.

195 Kennedy, Nature and Revelation Harmonious, 69. For Combe's reply to Kennedy, see George Combe, Answer by George Combe to the Attack on "The Constitution of Man", contained in "Nature and Revelation Harmonious: A Defence of Scripture Truths assailed in Mr. George Combe's Work on the Constitution of Man, etc., by the Rev. C.J. Kennedy, Paisley; Published under the Sanction of the Scottish Association for opposing Prevalent Errors", (Edinburgh, 1847).

196 C.J. Kennedy to George Combe, March 15, 1847, NLS MS.7286 f.33.

197 See for instance, George Combe to Robert Chambers, March 11, 1847, NLS MS.7391 f.27: "I am busy concocting more "blasphemy" in the form of a paper to be styled "The relation between science and religion" or "The order of nature, a guide for human conduct"."

198 Report [of the Scottish Association for Opposing Prevalent Errors], (Edinburgh, 1848), 2.

199 'Infidelity among the Working Classes', Free Church Magazine 6 (1849), 158.

200 'Notices of New Publications', United Secession Magazine 3 (1846), 173 (review of Kennedy, Nature and Revelation Harmonious).

201 John Law, 'Remarks on Combe's Pamphlet on the Relation between Religion and Science', United Presbyterian Magazine 2 (1848), 126.

202 'Aspects, Causes and Agencies of Infidelity', United Presbyterian Magazine 7 (1853), 351.

203 MacLaren, Religion and Social Class, 210.

204 For an example of Evangelical concern about the theology of Combe's school, and similar developments, see for instance Horatius Bonar, Truth and Error; or, Letters to a Friend, on some of the Controversies of the Day (Edinburgh, 1846), x-xi: "It is a singular fact, that the tendencies of the present day

are to substitue the operation of general laws for the direct interposition of God. This is Satan's device; and this is a device which he is carrying into all departments of knowledge, philosophy, science, literature, and theology." Bonar, who was a Free Church minister, cited Vestiges of the Natural History of Creation as an example of a tendency which also pervaded "the new theology" of certain divines.

205 Gibbon, Life of George Combe, i, 135.

206 George Combe to Thomas Chalmers, February 19, 1823, New College Library MS. CHA. 4.24.82.

207 George Combe to Thomas Chalmers, December 16, 1828, New College Library MS. CHA. 4.91.38. Combe refers to lectures he has already attended and asks permission to attend a further lecture on necessity.

208 George Combe to Thomas Chalmers, April 28, 1829, New College Library MS. CHA. 4.119.19.

209 'Literature', Scotsman, August 28, 1833.

210 George Combe to J.P. Nichol, November 22, 1836, NLS MS.7387 f.193.

211 William Hanna, Memoirs of the Life and Writings of Thomas Chalmers, 4 vols. (Edinburgh, 1849-52), iv, 208.

212 Thomas Chalmers, Sketches of Moral and Mental Philosophy ... Introductory Essays, and Tracts and Essays, Selected Works of Thomas Chalmers, D.D. LL.D. Edited by his son-in-law The Rev. William Hanna, LL.D., 12 vols. (Edinburgh, 1854-79), xii (1857), 2.

213 David Brewster to George Combe, n.d. [1821] NLS MS.7206 f.14. See also 'Remarks on Dr Brewster's Note to Dr Butler's Communication', Transactions of the Phrenological Society 1 (1823), 233-4 about Brewster's rejection of Butler's 'Phrenological Explanation of Colour Blindness'. This may have been the same paper.

214 David Brewster to Emma ? , March 31, 1827, St. Andrews University Library MS.1698.

215 For an account of the development of the mesmeric movement, see F. Kaplan, 'The Mesmeric Mania', Journal of the History of Ideas 35 (1974), 691-702. For more on phreno-mesmerism (which Combe opposed) see de Giustino, 'Phrenology in Britain', chap.4.

216 [David Brewster], 'Dr Roget's Bridgewater Treatise - Animal and Vegetable Physiology', Edinburgh Review 60 (1834), 178.

217 David Brewster to Macvey Napier, June 19, 1838, BL Add. MS.34619 f.161.

218 [David Brewster], 'Vestiges of the Natural History of Creation', North British Review 3 (1845), 503-4.

219 [David Brewster], 'Sir John Herschel's Astronomical Observations', North British Review 8 (1848), 520.

220 David Brewster, 'On the Characteristics of the Age', Good Words 4 (1863), 7-13. For further evidence of Brewster's opposition to the claims of spiritualists, see [David Brewster], 'Pretensions of Spiritualism - Life of D.D. Home', North British Review 39 (1863), 174-206.

221 Catalogue of the Valuable Library of the Late John Fleming, D.D., Professor of Natural Science in the New College, Edinburgh, consisting of an Interesting Collection of Books in Natural Science etc. (Edinburgh, 1860).

222 John Fleming to Patrick Neill, October 28, 1835, in John Fleming, The Lithology of Edinburgh; edited with a Memoir, by the Rev. John Duns, Torphichen (Edinburgh, 1859), lxxii-lxxiii.

223 Hugh Miller, My Schools and Schoolmasters; or, The Story of My Education (Edinburgh, 1854), 390.

224 Chalmers, On the Power Wisdom and Goodness of God, i, 32-34. Chalmers thought that "the more felicitous mode of viewing" the mind was "as a simple and indivisible substance, with the susceptibility of passing into different states". The alternative was to regard it as "a congeries of different faculties". However, "in either view of our mental constitution there is the same strength of evidence for a God".

225 Hugh Miller, First Impressions of England and its People (London, 1847), 117.

226 Hugh Miller, 'Introductory Remarks' in Sermons for Sabbath Evenings, by Ministers of the Free Church of Scotland (London, n.d.), xii-xiii. 'Emerson' was Ralph Waldo Emerson, who lectured at the Edinburgh Philosophical Institution in c.1848. For Morell see note 189.

227 Hanna, Memoirs of the Life and Writings, iv, 494-7. For more on the Free Church and education, see Andrew L. Drummond and James Bulloch, The Church in Victorian Scotland 1843-1874 (Edinburgh: St Andrew Press, 1975), chap.4.

228 Hugh Miller, Thoughts on the Educational Question; or, "The Battle of Scotland" (London and Edinburgh, 1850), 50.

229 Ibid., 42-43.

230 David Brewster to Adam Black, March 21, 1850, St. Andrews University Library MS.1076.

231 Brewster, Address delivered to the members of the Edinburgh

Philosophical Institution, 13.

232 David Brewster, 'Presidential Address' in Report of the British Association for the Advancement of Science ... 1850 (London, 1850), xliv.

233 George Combe, On the Relation between Religion and Science (Edinburgh, 1847), 38.

234 Advertisement for Williams' Secular School, Scotsman, August 27, 1853.

235 George Combe to William Mattieu Williams, November?, 1848, in William Mattieu Williams, A Vindication of Phrenology (London, 1894), xiv-xv.

236 'Summary', Scotsman, November 17, 1849. For other references to the School, see 'School for Secular Education', Scotsman, December 2, 1848; 'Williams' "Secular School"', Scotsman, April 7, 1849.

237 Drummond and Bulloch, Church in Victorian Scotland, 97-98.

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NOTES

Chapter Seven

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131 [Brewster], 'Rosse's Reflecting Telescopes', 211.

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136 Ibid., 338.

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144 Ibid., Table, 226-27.

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147 Robert Chambers to George Combe, March 14, 1847, NLS MS.7283 f.127.

148 J.P. Nichol to George Combe, February 25, 1848, NLS MS.7296 ff.80-81 complains of "as curious a history of the unblushing

and wholesale appropriation of another man's plans and thoughts as probably ever occurred". An earlier letter (J.P. Nichol to John Murray, March 10, 1845, EUL MS.Gen.1971/2/33) indicates that at that time Nichol had not even read Vestiges.

149 George Combe to J.P. Nichol, March, 18, 1848, NLS MS.7391 ff.349-50. See also James Coxe to the Editor, March 23, 1859, Critic, March 26, 1859 where Coxe claims that Combe "knew nothing of the "Vestiges" till he saw a published copy of the work".

150 [Chambers], Vestiges, 346-47.

151 Ibid., 153.

152 Ibid., 331.

153 Ibid., 377.

154 Ibid., 168 ("Almighty Deviser"), 198 ("Divine Author"), 348 ("Great Father"), 376 ("Great Ruler of Nature").

155 Ibid., 158. The passage, although slightly misquoted, is from Buckland, Geology and Mineralogy, i, 580. Buckland's original reads: "If the properties imparted to these Elements at the moment of their Creation, adapted them beforehand to the infinity of complicated useful purposes, which they have already answered, and may have further still to answer, under many successive Dispensations in the material World, such an aboriginal constitution so far from superseding an intelligent Agent, would only exalt our conceptions of the consummate skill and power, that could comprehend such an infinity of future uses under future systems, in the original groundwork of his creation."

156 David de Giustino, 'Phrenology in Britain, 1815-55: A Study of George Combe and his circle' (Ph.D. dissertation, University of Wisconsin, 1969), 82.

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158 J.P. Nichol, quoted in Critic, March 26, 1859. The original has "Lectures".

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York, 1888), i, 541-2.

162 [Adam Sedgwick], 'Natural History of Creation', Edinburgh Review 82 (1845), 85.

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166 J.D. Forbes to William Whewell, January 8, 1846, Library, Trinity College, Cambridge, Add.MS. a.204[70].

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169 James Coxe to the Editor, North British Daily Mail, March 25, 1859, suggests that Vestiges had recently been attributed to Combe in the catalogue. The date of 1860 or earlier was confirmed by staff of the Inquiry Desk, Reading Room, Department of Printed Books, British Library. For the 1877 date, see Alexander Ireland, 'Introduction', in Robert Chambers, Vestiges of the Natural History of Creation, Twelfth edition (London, 1884).

170 [Brewster], 'Vestiges of the Natural History of Creation', 471.

171 Hugh Miller, Footprints of the Creator: or, The Asterolepis of Stromness (London, 1849), 262-63.

172 'Literature', Scottish Guardian, September 23, 1845 (review of North British Review No.6, which contained [Brewster], 'Vestiges of the Natural History of Creation'). See also the reference to Fleming's lectures in [Brewster], 'Vestiges of the Natural History of Creation', 407.

173 John Fleming, The Institutes of Natural Science, exhibiting the arrangement followed in Lectures delivered by Dr Fleming in the New College, Edinburgh (Edinburgh, 1846), 18.

174 Fleming, 'Introductory Lecture on Natural Science', 218.

175 'New Publications Received', Edinburgh New Philosophical Journal 38 (1844-5), 186-88; 'New Publications Received', Edinburgh New Philosophical Journal 40 (1845-6), 399-400.

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177 William Parsons, Third Earl of Rosse, 'Observations on some of the Nebulae', Philosophical Transactions 134 (1844), 324.

178 [Sedgwick], 'Natural History of Creation', 19.

179 [W.H. Smith], 'Vestiges of the Natural History of Creation', Blackwood's Edinburgh Magazine 57 (1845), 448-50. Millhauser notes that Smith was later converted to the 'development' principle (Just Before Darwin, 154-5).

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184 [Brewster], 'Vestiges of the Natural History of Creation', 477.

185 [Chambers], Vestiges, 12-13.

186 For an example of a writer imputing atheism to Laplace, see for instance, 'Notes on Theology and Science', Macphail's Edinburgh Ecclesiastical Journal, 1849), 135.

187 [Brewster], 'Vestiges of the Natural History of Creation', 480.

188 [Brewster], 'The Earl of Rosse's Reflecting Telescopes', 206.

189 Ibid., 210-11.

190 [Brewster], 'Smith and Nichol on Celestial Objects', 240.

191 'The Nebular Theory', Witness, July 26, 1845. I have not been

able to locate the particular edition of Nichol's work to which this item refers.

192 Hugh Miller to Alexander Rose, n.d., in Mary Tweedie Stodart Rose, Alexander Rose, Geologist, and his Grandson Robert Traill Rose, Artist, (Edinburgh, 1956).

193 "Hutton Werner, Esq.", [John Fleming], 'Saunterings of a Geologist in the Neighbourhood of Edinburgh, No.II', Lowe's Edinburgh Magazine and Protestant and Educational Journal 2 (1847), 525. Evidence of Fleming's authorship is given in chapter five, note 84.

194 [Brewster], 'Of the Plurality of Worlds', 28-29.

195 Ibid., 25.

196 David Brewster, 'The Facts and Fancies of Mr. Darwin', Good Words 3 (1862), 8-9. For another example of the conflation of the nebular and development hypotheses see Graham Mitchell, The Young Man's Guide against Infidelity (Edinburgh, 1848), where the author claims to be refuting the theory of Vestiges but devotes nearly all the space to the difficulties attendant on the nebular hypothesis. Mitchell was a minister of the Church of Scotland.

197 Schweber, 'Auguste Comte and the Nebular Hypothesis'.

198 'Notes on Theology and Science' (see note 186).

199 [David Brewster], 'Murchison's Siluria', North British Review 21 (1854), 506.

200 Ibid., 544.

201 Miller, Footprints, 13-14.

202 Ibid., 18.

203 [Hugh Miller?], 'The Late Fast', Witness, October 20, 1849.

204 Miller, Old Red Sandstone, 232-6.

205 Miller, Sketch-book of Popular Geology, 206-7.

206 [John Duns], 'Genesis and Science', North British Review 27 (1857), 333.

207 Miller, Footprints, 286-7.

208 Miller, Sketch-book of Popular Geology, 232, quoting J.P. Nichol, The Planetary System (? , ?). I have not been able to locate this work.

209 Charles Lyell, Principles of Geology; or, the Modern Changes of

the Earth and its Inhabitants considered as Illustrative of Geology, Seventh edition (London, 1847), chap.33.

210 Miller, Sketch-book of Popular Geology, 232.

211 Miller, Footprints, 284.

212 Ibid., 290.

213 Ibid., 283.

214 Ibid., 307.

215 Ibid., 158.

216 Ibid., 162.

217 Ibid., 174n.

218 For more on Owen's anti-progressionism, see Adrian Desmond, 'Designing the Dinosaur: Richard Owen's Response to Robert Edmond Grant', Isis 70 (1979), 224-34.

219 Miller, Footprints, 157-58.

220 Ibid., 165-66.

221 'Footprints of the Creator', Free Church Magazine 6 (1849), 294.

222 Bowler, Fossils and Progress, 123-24.

223 Rupke, Great Chain of History, 178-79.

224 Sir R. Murchison to Hugh Miller, n.d. [1849], NLS MS.7527 f.63.

225 Richard Owen to Hugh Miller, n.d., NLS MS.7516 f.225. For more on Owen's reaction to Vestiges, see John H. Brooke, 'Richard Owen, William Whewell, and the Vestiges', British Journal for the History of Science 10 (1977), 132-45.

226 [David Brewster], 'Miller's Footprints of the Creator', North British Review 12 (1849-50), 443-81.

227 [Brewster], 'Vestiges of the Natural History of Creation', 501.

228 David Brewster, Address delivered to the members of the Edinburgh Philosophical Institution, On the 11th November, 1851 (London, 1852), 30.

229 [Brewster], 'Miller's Footprints of the Creator', 480.

230 David Brewster, More Worlds than One The Creed of the Philosopher and the Hope of the Christian (London, 1854), 51.

231 David Brewster, 'On a Horseshoe Nail in the Old Red Sandstone of

Kingoodie' in 'Transactions of the Sections - Geology' in Report of the British Association for the Advancement of Science; 29th Meeting held at Aberdeen, September 1859 (London, 1859), 101.

232 [Brewster], 'Murchison's Siluria', 539n.

233 'Literature', Scotsman, November 16, 1844. See also the favourable remarks on Chambers' Explanations in 'Literature', Scotsman, January 24, 1846.

234 George Combe to Mrs. L. Mott, October 10, 1844, in Charles Gibbon, The Life of George Combe, Author of "The Constitution of Man", 2 vols. (London, 1878), ii, 188.

235 George Combe to C.J. Kennedy, January 29, 1847, NLS MS.7390 f.632 claims: "I was taken by surprize [sic] by it [the development theory] when I first read it in the "Vestiges" of Creation, in the end of 1844, or beginning of 1845; It had never previously entered into my imagination, and I have never embraced it".

236 George Combe, The Constitution of Man considered in Relation to External Objects, Eighth edition (Edinburgh, 1847), 3-4 and 4n.

237 J.P. Nichol to the Editor, Scottish Guardian, March 23, 1846. Reprinted in Witness, March 28, 1846. For a more detailed recantation, see J.P. Nichol, Thoughts on some important points relating to the System of the World (Edinburgh, 1846), especially 65-66.

238 J.P. Nichol, 'Nebular Hypothesis', in Cyclopaedia of the Physical Sciences (London, 1857), 529. For more on the changing fortunes of the nebular theory after Vestiges, see Ronald L. Numbers, Creation by Natural Law: Laplace's Nebular Hypothesis in American Thought (Seattle: University of Washington Press, 1977); John H. Brooke, 'Nebular Contraction and the Expansion of Naturalism' (Essay review of Numbers, Creation by Natural Law), British Journal for the History of Science 12 (1979), 200-211.

239 J.P. Nichol, The Stellar Universe: Views of its Arrangements, Motions and Evolutions (Edinburgh, 1848), 216.

240 Ibid., 90-91.

241 J.P. Nichol, 'The Limitations essential to Every Speculation in Cosmology', [Lecture to the Edinburgh Philosophical Institution], Free Church Magazine 3 (1846), 7-14, 101-5.

242 J.P. Nichol, Thoughts on some important points relating to the System of the World (Edinburgh, 1846), vii-viii.

243 Ibid., 233n.

244 J.P. Nichol to Thomas Chalmers, March 10, 1846, New College Library MS. CHA. 4.32.6.

245 Witness, April 9, 1845.

246 Free Church Magazine 3 (1846), 252-53 (notice of Nichol, System of the World).

247 'The Stellar Universe' (see note 125).

248 J.P. Nichol, 'Address delivered at the Soiree of the Stirling School of Arts, on the 10th January 1849', in The Importance of Literature to Men of Business: A Series of Addresses delivered at Various Popular Institutions. Revised and Corrected by the Authors (London, 1852), 237 and 237n.

249 M.B. Ogilvie, 'Robert Chambers and the the Nebular Hypothesis', British Journal for the History of Science 8 (1975), 214-32.

250 [Robert Chambers], Explanations: a Sequel to the Vestiges of the Natural History of Creation (London, 1845), 179. For Brewster's review of Explanations, see [David Brewster], 'Explanations. By the Author of the Vestiges of the Natural History of Creation', North British Review 4 (1845-46), 487-504.

251 Scotsman, November 28, 1848, reports that Miller and Chambers were elected presidents. Chambers and Fleming were elected presidents on December 27, 1854. (Proceedings of the Royal Physical Society of Edinburgh 1 (1854-58), 8.) They may have shared the presidency before this but the Proceedings do not start until 1854.

252 Hugh Miller to Robert Paul, n.d. [1839], NLS MS.5139 f.214.

253 Porter, Making of Geology, 149-56.

254 John Fleming, 'On the Different Branches of Natural History, the Chairs which have been Instituted for their Illustration and the Manner in which they should be Subordinated', [read before the British Association for the Advancement of Science, Glasgow, September 13, 1855] Edinburgh New Philosophical Journal 3 (Third Series) (1856), 133.

255 Thomas Burnet, The Theory of the Earth: containing an Account of the Original of the Earth, and of all the General Changes which it hath already undergone, or is to undergo, till the Consummation of all Things 2 vols. (London, 1684).

NOTES

Chapter Eight

1 Reyer Hooykaas, Natural Law and Divine Miracle. The Principle of uniformity in Geology, Biology and Theology, Second impression (Leiden: E.J. Brill, 1963), 203.

2 David Brewster to Henry Brougham, October 23, 1841, UCL MS.26.621.

3 Hugh Miller, The Two Parties in the Church of Scotland, exhibited as Missionary and Anti-Missionary; Their Contendings in these Opposite Characters in the Past, and their Statistics Now (Edinburgh, 1841), 32.

4 Charles Coulston Gillispie, Genesis and Geology A Study in the Relations of Scientific Thought, Natural Theology and Social Opinion in Great Britain, 1790-1850 (New York: Harper Torchbooks, 1959), chap.6.

5 [David Brewster], 'Whewell's Astronomy and General Physics', Edinburgh Review 58 (1834), 456.

6 John H. Brooke, 'The natural theology of the geologists: some theological strata' in L.J. Jordanova and R.S. Porter (eds.) Images of the Earth: essays in the history of the environmental sciences (Chalfont St. Giles: British Society for the History of Science, 1979), 39-64.

7 [David Brewster], 'Vestiges of the Natural History of Creation', North British Review 3 (1845), 498n.

8 'Kirby's Bridgewater Treatise', Presbyterian Review 7 (1835-6), 586-87.

9 J.D. Forbes, for instance, complained to William Whewell that he found the article "a grievous failure" not "in point of argument" but "in the method of putting it & the temper in which it was put." (J.D. Forbes to William Whewell, January 8, 1846, Trinity College, Cambridge Add. MS. a.204.[70].)

10 See for instance Hugh Miller, Footprints of the Creator: or, the Asterolepis of Stromness (London, 1849), 19: "The evangelistic Churches cannot, in consistency with their character, or with a due regard to the interests of their people, slight or overlook a form of error at once exceedingly plausible and consummately dangerous, and which is telling so widely on society, that one can scarce travel by railway or in a steam-boat, or encounter a group of intelligent mechanics, without finding decided traces of its ravages."

11 Hooykaas, Natural Law and Divine Miracle, 203.

12 'Edinburgh Philosophical Association', Scotsman, October 10, 1835.

13 Steven Shapin, 'Homo Phrenologicus: Anthropological Perspectives on an Historical Problem', in Barry Barnes and Steven Shapin (eds.) Natural Order: Historical Studies of Scientific Culture (Beverley Hills/London: Sage Publications, 1979), 41-71.

14 George Combe, Moral Philosophy; or, the Duties of Man considered in his Individual, Domestic and Social Capacities. Second impression of the third edition. Revised, corrected and enlarged. (Edinburgh, 1855), 109.

15 There is a vast literature on scientism, but as an historical introduction, I would recommend Robert M. Young, 'The Historiographic and Ideological Contexts of the Nineteenth Century Debate on Man's Place in Nature', in M. Teich and Robert M. Young (eds.) Changing Perspectives in the History of Science (London: Heinemann, 1973), 344-438.

16 For an account of the eugenics movement in Britain, see Donald MacKenzie, 'Eugenics in Britain', Social Studies of Science 6 (1976), 499-532.

17 William Ballantyne Hodgson to ?, February 27, 1858, in J.M.D. Meiklejohn (ed.) The Life and Letters of William Ballantyne Hodgson (Edinburgh, 1883), 301.

18 Andrew L. Drummond and James Bulloch, The Church in Victorian Scotland 1843-1874 (Edinburgh: St Andrew Press, 1975), 113.

19 Milton Millhauser, Just before Darwin. Robert Chambers and Vestiges (Middletown, Connecticut: Wesleyan University Press, 1959).

20 George Jacob Holyoake, Sixty Years of an Agitator's Life 2 vols. (London, 1892), i, 60. For accounts of the development of British secularism see Edward Royle, Victorian Infidels: the origins of the British Secularist Movement (Manchester: Manchester University Press, 1974); Susan Budd, Varieties of Unbelief: Atheists and Agnostics in English Society, 1850-1960 (London: Heinemann, 1977).

21 James McCosh, The Method of the Divine Government, Physical and Moral (Edinburgh, 1850); see also idem, 'Typical Forms', North British Review 15 (1851), 389-418.

22 For a biography of McCosh see William M. Sloane (ed.) The Life of James McCosh A Record Chiefly Autobiographical (Edinburgh, 1896). For a recent study see J. David Hoeveler, James McCosh and the Scottish Intellectual Tradition: from Glasgow to Princeton (Princeton: Princeton University Press, 1981). See also N.T. Phillipson, 'The Evangelist of Common Sense', Times

Literary Supplement, October 23, 1981.

23 See for instance Hugh Miller, The Testimony of the Rocks or Geology in its Bearings on the Two Theologies, Natural and Revealed (Edinburgh, 1857), 214, where there is a reference to McCosh's "very masterly work on typical forms".

24 Nicholas Phillipson, 'Sir David Brewster: some concluding remarks' in A.D. Morrison-Low and J.R.R. Christie (eds.) 'Martyr of Science': Sir David Brewster 1781-1868 (Edinburgh: Royal Scottish Museum, 1984), 80.

25 James R. Moore, The Post-Darwinian Controversies: A Study of the Protestant Struggle to come to terms wth Darwin in Great Britain and America, 1870-1900 (Cambridge: Cambridge University Press, 1979).

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Christian Journal
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Church Review and Scottish Ecclesiastical Magazine
Dalrymple's Secession Magazine (later Secession Witness and Religious Examiner)
Edinburgh Advertiser
Edinburgh Christian Instructor
Edinburgh Christian Magazine
Lowe's Edinburgh Magazine and Protestant and Educational Journal
Macphail's Edinburgh Ecclesiastical Journal and Literary Review
Phrenological Journal and Miscellany
Presbyterian Review and Religious Journal
Scotsman
Scottish Christian Herald
Scottish Guardian
United Presbyterian Magazine
United Secession Magazine
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APPENDIX ONE

Principal Manuscript Collections Consulted.

British Library (BL)

Edinburgh University Library (EUL)

King's College, Aberdeen, Library

National Library of Scotland (NLS)

New College Library, Edinburgh

Royal Society Library

St. Andrews University Library

Trinity College, Cambridge, Library

University College London, Library (UCL)

Fleming-Lyell correspondence, Library of the American Philosophical Society, Philadelphia (held on microfilm, Edinburgh University Library)

APPENDIX TWO

List of religious periodicals and newspapers with affiliations

Church of Scotland : Evangelical (Pre-1843)

Church of Scotland Magazine.

Edinburgh Christian Instructor.

Presbyterian Review and Religious Journal.

Scottish Christian Herald.

Scottish Guardian.

Witness.

Church of Scotland : Moderate (Pre-1843)

Church Review and Scottish Ecclesiastical Magazine.

Free Church of Scotland

Free Church Magazine.

Lowe's Edinburgh Magazine and Protestant and Educational Journal.

Scottish Guardian.

Witness.

The *North British Review* was also loosely associated with the Free Church interest.

Church of Scotland (Post-1843)

Church of Scotland Magazine.

Edinburgh Christian Magazine.

Macphail's Edinburgh Ecclesiastical Journal and Literary Review.

Relief Church

Christian Journal.

United Secession Church (or United Associate Synod)

Dalyrmple's Secession Magazine. (Name later changed to Secession Witness and Religious Examiner.)

United Secession Magazine.

United Presbyterian Church (formed in 1847 by Union of the Relief Church and the United Secession Church)

United Presbyterian Magazine.